LITERATURE ON ANTIBIOTICS (1996-1999): A BIBLIOMETRIC STUDY

DISSERTATION

Submitted in partial fulfilment of the requirements for the award of the degree of

Master of Library & Information Science

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By

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CERTIFICATE

This is to certify that **Mr. Ravindra Kuman Sahagal** has completed his dissertation entitled "***Literature on Antibiotics (1996-1999): A Bibliometric Study***", in partial fulfilment of the requirements for the Degree of **Master of Library and Information Science** (1999-2000). He has conducted the work under my supervision and guidance. I deem it fit for submission.

Prof. Shabahat Husain
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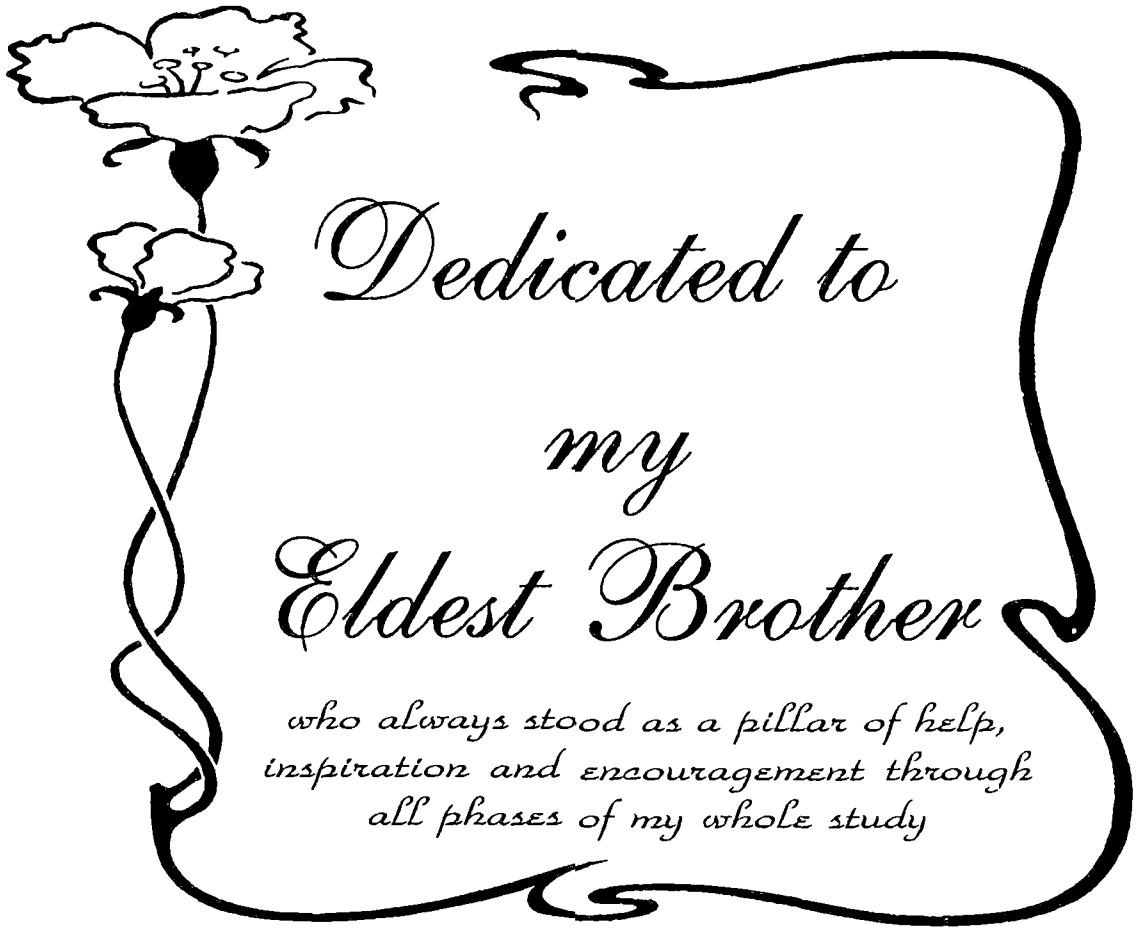
Dedicated to
my
Eldest Brother
who always stood as a pillar of help,
inspiration and encouragement through
all phases of my whole study

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R.K. Sahagal

(RAVINDRA KUMAR SAHAGAL)

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CHAPTER — 1

BIBLIOMETRICS

1. INTRODUCTION

The word bibliometrics has been derived from the two words 'Biblion' and 'Metric'. The word 'Biblion' means Books and 'Metric' means measurement. So, Bibliometrics generally means 'Measurement pertaining to Books'.

'Bibliometrics' is relatively a subject of recent origin. It is that branch of information science, which lies between the border areas of the social and physical sciences. It is a quantitative study of various aspects of literature on a topic and is used to identify the pattern of publication, authorship, citations and/or secondary journal coverage with the objective of getting an insight into the dynamics of the growth of knowledge in the areas under consideration. This all consequently leads to the better organisation of information resources which is

essential for its most effective and efficient use. Bibliometrics today has attained sophistication and complexity having national, international and interdisciplinary character. As Lawani says, "Bibliometrics has clearly become established as a sub - discipline with application in the history and sociology of knowledge in communication and information science".

2. ORIGIN

Though the term 'Bibliometrics' was first coined by Pritchard in 1969, its usage and practice can be traced back to the second decade of this century. A pioneer example is of a bibliometric study conducted by Cole and Eales in 1917. They conducted a "Statistical analysis of the literature" of comparative anatomy from 1543 to 1860 by counting the number of titles, both books and journal articles, and grouping them by countries of origin within periods. It was followed in 1923 by a second study "Statistical analysis of the history of science" by Hulme. His analysis was based on the original entries in the seventeen sections of the "English International Catalogue of Scientific Literature". The third study was the pioneering work of Gross and Gross reported in 1927. They used the method of counting and analysing the citations appended to articles in the Journal of the American Chemical Society, and produced a list of journals of importance in chemical education. As per the historians of bibliometrics, this was the first

recorded study based on counting and analysing of citation i.e. citation analysis. The fourth and the most prominent work was of Bradford in 1934 on the distribution of papers among journals in Applied Geophysics and in Lubrication Research. It formed the backbone of the theoretical foundation of the 'Bibliometric' study, know as the "Bradford's law of scattering."

3. DEFINITIONS

A number of definitions of bibliometrics were given by the different scholars as given below:

i) Hulme (1923) :

According to him "The purpose of statistical bibliography is to shed light on the process of written communication and of the nature and course of development of a discipline, by means of counting and analysing the various facets of written communication".

ii) Raising (1962) :

Defined it as a "The assembling and interpretation of statistics relating to books and periodicals... to demonstrate historical movement to determine national and universal research use of books and journals".

iii) Pritchard (1969) :

Defined "Application of mathematical methods to books and other media of communication".

iv) British Standard Institute :

Defined "Bibliometric as the study of the use of documents and patterns of publication in which mathematical and statistical method have been applied".

v) Sengupta :

"Organization, classification and quantitative evaluation of publication patterns of all macro and micro communications along with their authorship by mathematical and statistical calculus".

vi) Schrader :

"Bibliometric is the scientific study of recorded discourse".

vii) Hamkins (1977) :

"Quantitative analysis of the bibliographical features of a body of literature.

viii) Potter (1981) :

"Bibliometric is the study and measurement of the publication patterns of all forms of written communication and their authorship".

4. BIBLIOMETRICS : Its Scope

The scope of bibliometrics includes the study of relationship within a literature or describing a literature. Typically these descriptions focus on consistent patterns involving Authors, Monographs, Journals, Subject, Language forms.

Bibliometric studies fall mainly into two broad groups:

(a) **Descriptive studies :** Those describing the characteristics or features of literature.

(b) **Behavioural studies:** Those examining the relationship formed between components of a literature.

The techniques of bibliometrics are simple to complex in nature. The basic units of bibliometric are all facets of written communication, such as Primary and Secondary periodicals, articles, books, monographs and other media of communication. Bibliometric techniques have been extensively applied equally in sociological studies of science information management, librarianship, history of science including science policy, study of science and scientists and also in different branches of social science. Bibliometric laws are useful in understanding some of the information phenomena and may help in planning many of the library activities, as they indicate certain basic patterns and relationships governing information items and activities. The study mostly relates to quantification of

items and their pattern of distribution. Hyperbolic distribution and exponential growth are the prominent trends under lying information and document phenomena. The studies throw light on the pattern of growth of literature, productively and influence of authors, interrelationship among different branches of knowledge, distribution of terms in information storage and retrieval pattern of collection build up, their use and the like.

5. PURPOSE OF BIBLIOMETRICS

Hulme assigned its purpose as to shed light on the processes of written communication and of the nature and course of development of a discipline by means of counting and analysing the various facets of written communication.

According to Dr. S.N. Singh "The purpose of bibliometric is to provide quantitative analysis of the phenomenon going with documents, their organization, use and services in library and information centres and systems". It offers to the information worker a type of statistical technique for the study of characteristics and attributes of literature and that of communication media.

The main purpose of bibliometric study is:

- To find out major form of literature
- To prepare a ranked list of journals.
- To make a comparison between the ranked journals.

- To find out the chronological scattering of all cited literature.
- To identify the country with greatest literary output
- To ascertain the amount of utilization of language..
- To develop norms and standardization.
- To regulate inflow of information and communication.
- To identify authorship and its trends in documents of different subject

6. UTILITY OF BIBLIOMETRICS IN RESEARCH

At present, bibliometric work often provides the background for a more practical task. It is an established technique covering wide area of knowledge. It has therefore, been able to involve scholars from many of these discipline. Consequently it has attracted scholars from different disciplines or their respective fields. Day by day, it is attaining sophistication and complexity having national, international and interdisciplinary character. It has established itself as viable and distinctive research technique for studying science of sciences based on bibliographic data. As a matter of fact, its backbone lies in its sound theoretical foundation most efficiently and effectively laid by some pioneers like Gross and Gross, Lotka, Bradford, Zipf, Derek De Solla Price, Bookstein, Massavesik, Cole Brothers, Pritchard, Garfield, Hulme, Fairthorne and many others who are all not basically librarians, but belong to different branches of knowledge.

The techniques evolved by these pioneers are capable of throwing light to various complicated problems faced by many while handling information to quantify the process of written Communication. It has established itself as viable and distinctive research tool for quantitative measurement of human knowledge. Data analysis both of citations and of volume of publications year by year can be useful in planning retrospective bibliographies.

Bibliometrics also provides information about the structure of knowledge. Its classification studies give information about the subject, language and country relationship which is based on literary warrant. Bibliometric is very useful in any field of research or in any discipline or it can be used in small and manageable ways by individuals, to improve some part of library or information service.

7. BIBLIOMETRIC LAWS

There are three fundamental laws which laid the foundation of Bibliometrics:

7.1 Lotka's inverse square law of scientific productivity (1926)

7.2 Zipf's Law of Word Occurrence (1949)

7.3 Bradford's Law of Scattering (1948)

7.1 Lotka's Inverse Square Law (1926)

The frequency distribution of productivity of authors of scientific papers was first studied by Alfred Lotka, who proposed that the number of authors making 'n' contributions is about $1/n^2$ of those making one contribution, and the proportion of all contributors who make a single contribution is about 60% or $a(n) \doteq k/n^2$

Where 'a' is the number of authors producing n papers and k is a constant.

In other words, for every 100 authors contributing one article, 25 will contribute two articles, about 11 will contribute 3 articles and 6 will contribute 4 articles and so on.

7.2 Zipf's Law (1949)

This law states that "In a long textual matter if words are arranged in their decreasing order of frequency then the rank of any given word of text will be inversely proportional to the frequency of occurrence of the word."

Formula: $r \propto 1/f$

or $r = c/f$

or $rf = c$

Here r is the rank and f is the frequency of word occurrence and c is a constant.

Table – 1 shows that the distribution of words is inversely proportional to the frequency of occurrence of the words. In this table 400 is constant The law represents only approximation of the relationship between the rank and frequency of occurrence which is hyperbolic. Zipf's law has much potential for the descriptive evaluation of the subject authority files and related aspects of indexing.

TABLE – 1

Rank	Frequency	Product (rf = c)
1	400	400
2	200	200
3	133	399
4	100	400
5	80	400
6	66	396
7	58	406
8	50	400
9	41	369
10	40	400

7.3 Bradford's Law of Scattering (1948)

This law was given by S.C. Bradford in 1948. S.C. Bradford examined two bibliographies prepared in the science library on applied Geophysics and Lubrication and he prepared lists of journals arranged by decreasing order of source items contributed by the journals to the bibliographies.

He noticed that in each subject, there are a few very productive sources, and then a large number of sources of constantly diminishing productivity In the list of periodicals ranked by diminishing productivity, Bradford identified three groups of periodicals that produced approximately the same number of articles on the subject, but the number of periodicals in these three equi-productive zones increased by a constant factor.

Based on this he stated this law as, "If scientific periodicals are arranged in order of decreasing productivity of articles on a given subject that may be divided into a nucleus of periodicals more particularly devoted to the subject and several groups or zones containing the same number of articles as the nucleus when the number of periodicals in the nucleus and succeeding zones will be given as·

$$1 : n : n^2$$

8. APPLICATION OF BRADFORD'S LAW

There are some applications of Bradford's Law:

1. It helps us to check the completeness of bibliography.
2. It helps in serial control.
3. It helps in library service to use.
4. Bradford's law gives strength to Pareto Law.

9. APPLICATION OF BIBLIOMETRICS

As bibliometrics lies between the border areas of social sciences and physical sciences, its techniques have extensive applications equally in sociological studies of science, information management, librarianship, history of science and also in some other branches of social science and sciences. Some of the areas where bibliometric techniques are consistently being applied are enumerated here:

- To design information services.
- In library Management.
- Evaluation of indexing services and retrieved system.
- Weeding and stacking policy.
- To find out core journals by applying Bradford's law.

- To find out the productivity of scientists by applying Lotka's law
- Help in preparation of bibliographies
- To find out the relative use of different languages
- To study the use of literature from different countries.
- To study the scattering of subject.

10. CONCLUSION

Bibliometrics is a well established discipline for a quantitative study of various aspect of literature of a given subject In all subject discipline bibliometric has developed a body of theoretical knowledge and a group of techniques and application based on the distribution of bibliographic data elements. Bibliometric has emerged as the most active field of library and information science during the past few decades. Bibliometric methods based on statistical analysis can, thus, be used for eliminating low quality literature and to select a small portion of significant, reliable and relevant high quality publication. Such studies may be useful for acquisition of materials, provision of better services to patrons and knowing the location of materials. What part of literature is cited most, for how long the literature remains useful to readers, and language of most cited publications. Knowledge of all these provides guidance to collection development policies, selection, and retention and binding decisions.

Due to all these factors bibliometrics today has attained sophisticated complexity having national, international and inter disciplinary character.

CHAPTER — II

ANTIBIOTICS

1. INTRODUCTION

An antibiotic is drug obtained from living micro-organism i.e. bacteria, actinomycetes, yeast and moulds, and can kill or inhibit the growth of other micro-organisms. Depending upon the type of action, these are called bactericidal or bacteriostatic antibiotics. Bactericidals are those which kill micro-organisms while bacteriostatic only inhibit their growth. Ordinarily bacteriostatic drugs can act as bactericidal in higher concentration. Some act upon specific micro-organisms. Whereas others may act on several kinds. Those which act against several types of Micro-organisms are called 'broad spectrum' antibiotics.

2. HISTORY

The first investigators to recognize the clinical potential of microbial products as therapeutic agents were Pasteur and Joubert, who recorded their observations and speculations in 1877. They noted that *Anthrax bacilli* grew rapidly when inoculated into sterile urine but failed to multiply and soon died if one of the "Common" bacteria of the air was introduced into the urine at the same time. The same type of experiment in animals produced similar results They commented on the fact that life destroys life among the lower species even more than among higher animals and plants, and came to the astonishing conclusion that *Anthrax bacilli* could be administered to an animal in large numbers and it would not sicken, provided that "ordinary" bacteria were given at the same time. During the latter part of the nineteenth century and the early years of the twentieth century, several antimicrobial substances were demonstrated in bacterial cultures, and some were even tested clinically but discarded because they proved to be highly toxic.

The modern era of antibiotics started with the clinical use of sulfanilamide in 1936. The "golden age" of antibiotics began with the production of penicillin in 1941, when this compound was mass produced and first made available for limited clinical trial. At least 30% of all hospitalized patients now receive one or more courses of therapy with antibiotics, and millions of potentially fatal

infections have been cured. However, at the same time, these agents are among the most misused by the practicing physician. One result of their widespread use has been the emergence of antibiotic resistant pathogens, which in turn has fueled an even increasing need for new drugs. These agents have contributed significantly to the rising costs of medical care.

3. DEFINITION

3.1 1 "Antibiotics are chemical substances produced by some micro-organisms (bacteria, fungi, actinomycetes) that can kill or suppress the growth of other micro-organisms"

3.2 "A chemical substance produced by micro-organisms that has the capacity, in dilute solutions, to inhibit the growth of other micro-organisms or destroy them".

3.3 "These are substances produced by microorganisms, which suppress the growth of or kill other micro-organisms at very low concentrations."

3.4 "Antibiotics are chemical substances elaborated by various species of micro-organisms, such as fungi actinomycetes and bacteria; they suppress the growth of other microorganisms and may ultimately destroy them in low concentrations ".

4. CLASSIFICATION OF ANTIBIOTICS

Antibiotics can be classified in many different ways as given below

4.1 Chemical structure

4.2 Mechanism of Action

4.3 Organisms against which antibiotics is primarily active

4.4 Spectrum of Activity

4.5 Type of Action

4.6 Sources of Antibiotics

4.1 Chemical Structure

On the basis of chemical structure, Antibiotics are classified as under :

4.1.1. Sulfonamides and related drugs: Sulfadiazine and others, Sulfones Dapsone (DDS), paraaminosalicylic acid (PAS).

4.1.2. Diaminopyrimidines: Trimethoprime, Pyrimethamine

4.1.3. β-lactam Antibiotics: Penicillins, Cephalosporins, Monobactams, Carbapenems.

4.1.4. Tetracyclines: Oxytetracycline, Doxycycline etc.

4.1.5. Nitrobenzene derivative: chloramphenicol

4.1.6. Aminoglycosides: Streptomycin, Gentamicin, Neomycin etc

4.1.7 Macrolide antibiotics: Erythromycin, oleandomycin, Roxithromycin

4.1.8 Polypeptide antibiotics: Polymyxin-B, colistin, Bacitracin, tyrothricin.

4.1.9 Nitrofuran derivatives: Nitrofurantoin, Furazolidone.

4.1.10 Nitroimidazoles: Metronidazole, tindidazole

4.1.11 Quinolones: Nalidixic acid, Norfloxacin, Ciprofloxicin

4.1.12 Nicotinic acid derivatives: Isoniazid, Pyrazinamide, Ethionamide.

4.1.13 Polyene antibiotics: Nystatin, Amphotericin-B, Hamycin.

4.1.14 Imidazole derivatives: Miconazole, Ketoconazole

4.1.15 Others: Rifampin, clindamycin, spectinomycin, lincomycin, cycloserine.

4.2 Mechanism of Action

On the basis of Mechanism of Action, Antibiotics are classified as under:

4.2.1 Inhibit cell well synthesis: Penicillins, cycloserine, vancomycin, Bacitracin..

4.2.2 Cause leakage from cell membranes.

Polypeptides- Plymyxins, colistin, Bacitracin

Polyenes – Amphotericin B, Nystatin, Hamycin.

4.2.3 Inhibit protein synthesis: Tetracyclines, chloramphenical, Erthromycin, Clindomycin.

4.2.4 Cause misreading of m-RNA code (bind to 30S ribosomes): Aminoglycosides streptomycin etc.

4.2.5 Interfere with DNA function: Rifampin, Norfloxacin, Metronidazole.

4.2.6 Interfere with DNA synthesis: Idoxuridine, Acyclovir, Zidovudine.

4.2.7 Interfere with intermediary metabolism; Sulfonamides, sulfones, PAS, Trimthoprime, pyrimethamine, Ethambutol.

4.3 Organisms Against Which Antibiotics is Primarily Active

On the basis of organisms against which antibiotics is primarily active, antibiotics are classified as, under:

4.3.1	Antibacterial	:	Penicillins, Aminoglycosides, Erythomycin etc.
4.3.2	Antifungal	:	Girseofulvin, Amphotericin B, etc.
4.3.3	Antiviral	:	Acyclovir, Amantadine, Zidovudine etc.
4.3.4	Antiprotozoal	:	Chloroquine, Pyrimethamine, Diloxianide etc.
4.3.5	Anthelmintic	:	Mebendazole, Pyrantel, Niclosamide, etc.

4.4 Spectrum of Activity

On the basis of spectrum of activities, antibiotics are grouped into

a) Narrow spectrum

Ex. Penicillin G
Streptomycin
Erythromycin

b) Broad spectrum

Ex. Tetracyclines

Chloramphenical

The initial distinction between narrow and broad spectrum antibiotics is no longer clear cut. Drugs with all ranges of intermediate band width e.g. extended spectrum penicillins, newer, cephalosporin, aminoglycosides, fluoroquinolones are now available.

4.5 Type of action

a) Primarily bacteristatic

Ex. Sulfonamides

Tetracyclines

Chloramphenicol

b) Primarily bactericidal

Ex. Penicillins

Aminoglycosides

Polypeptides

Some primarily static drugs may become cidal at higher concentrations (as attained in the urinary tract) e.g. Sulfonamides. On the other hand some cidal drugs may only be static under certain circumstances e.g. Penicillins

4.6 Sources of Antibiotics

Antibiotics are also classified on the basis of sources from where the6 are obtained as given below.

a) Fungi

Ex. Penicillin

Cephalosporin

b) Bacteria

Ex. Polymyxin B

Tyrothricin

c) Actinomycetes

Ex. Tetracyclines

Chloramphenicol

5. NEED OF ANTIBIOTICS

There is no doubt that antibiotics have proved their value and saved millions of lives, they have saved us from incapacitating complications of various diseases like typhoid, pneumonia, tuberculosis and many more. However, at least in one respect we would have been better off if antibiotics had not been discovered. Then scientists would have made more intensive efforts towards developing methods to increase our body resistance to infections.

6. ROLE OF ANTIBIOTICS IN PREVENTION OF DISEASE

Antibiotics are not only useful in an established condition of infection but are also effective as prophylactic agents in a variety of situations,. The prophylactic use of antibiotics is advocated before and after infection of gonorrhea; to prevent secondary bacterial infections in persons suffering from viral diseases; to reduce the risk of infection in chronic patients who are more susceptible to infections due to decreased resistance; and to avoid the spread of infection after accidents, injury or surgery.

7. PROBLEMS PERTAINING TO THE ANTIBIOTICS

7.1 Selection of an antibiotics

The ideal method of selection is to carry out a bacterial culture sensitivity test in the laboratory before starting the treatment. However, in cases where the infection is very severe and the disease is likely to make fast progress until the sensitivity report is received (it takes at least 24 hours), antibiotic therapy is started by the doctor on the basis of his clinical judgement. Self-administration of antibiotics can be very detrimental to health.

7.2 Failure of Response

If a patient has been taking a particular antibiotic frequently the bacteria in his system are likely to become resistant to it. The failure of response due to inadequate or inappropriate therapy involves several factors, some of which could be avoided by a vigilant doctor and others by the patient.

7.2.1 The Patients' Role

In our country where most of the population is poor, people hesitate to purchase expensive drugs like antibiotics. When a doctor prescribes an antibiotics, the patient thinks twice before he finally makes up his mind to buy these, and in this process he loses valuable time. The patient thus postpones the treatment until the infection becomes serve, and stops the drugs as soon as symptoms are relieved, without completing a full course. This leads to the development of bacterial resistance, and on subsequent treatment with the antibiotic there is no response.

7.2.2 The Pharmacists' Role

In some cases, a patient takes either less than the dose prescribed or decreases the frequency of the intake advised by the physician. If for example, a correct dose of an antibiotic is 250mg four times a day (a total of 1 g) and the patient takes it only two or three times a day (a total of 500 or 750mg) then this inadequate dose leads to the development of bacterial resistance. It is the duty of

community pharmacist to bring home these points to the patient. He can thus play a very effective role.

7.2.3 The Doctors' Role

A common misuse of these antibiotics is an employing them where they are ineffective e.g. virus infections such as chickenpox and the vast majority of infections of the upper respiratory tract which are not cured by antibiotics. It is said that in all these conditions, antibiotics are given to prevent secondary bacterial infections, but how far this is justified, is still a subject to controversy.

7.3 **Drug Resistance**

7.3.1 Natural Resistance

Some microbes have always been resistant to certain antibiotic. They lack the metabolic process, which is affected by the particular drug. It is generally a group or species characteristics e.g. gram negative bacilli are normally unaffected by penicillin G or M. This type of resistance does not pose significant clinical problem.

7.3.2 Acquired Resistance

It is the development of resistance by an organism due to the use of an antibiotic over a period of time. This can happen with any microbe and is a major clinical problem.. However, development of resistance is dependent on the micro-

organism as well as the drug. Some bacteria are notorious for rapid acquisition of resistance e.g. staphylococci, coliforms, *Tubercle bacilli.*

7.3.3 Resistance by Mutation

It is a stable and heritable genetic change that occurs spontaneously and randomly among micro-organisms. It is not induced by the antibiotic. Mutation and resistance may be of following types :

7.3.3.1 *Single Step*

A single gene mutation may confer high degree of resistance; emerges rapidly e.g. enterococci to streptomycin, E. Coli and staphylococci to rifampin.

7.3.3.2 *Multi Step*

A number of gene modifications are involved; sensitivity decreases gradually in a stepwise manner. Resistance to erythromycin, tetracyclines and Chloramphenicol is developed by many organism in this manner.

7.3.4 Resistance by Gene transfer (Infectious resistance)

From one organism to another can occur by:

7.3.4.1 *Conjugation*

Sexual contact through the formation of a bridge is common among gram negative bacilli of the same or another species. This may involve chromosomal DNA. The gene carrying the 'resistance' or 'R' factor is

transferred only if another 'resistance transfer factor' (RTF) is also present. Chloramphenicol resistance of typhoid bacilli, streptomycin resistance of E coli, penicillin resistance of Haemophilus and gonococci and many others have been traced to this Mechanism. Concomittant acquisition of multi drug resistance has occurred by conjugation.

7.3.4.2 *Transduction*

It is the transfer of gene carry resistance through the Agency of bacteriophange. The R factor is taken up by the phase and delivered to another bacterium which it infects. Certain instances of penicillin, erythromycin and chloramphenicol resistance have been found to be phage mediated.

7.3.4.3 *Transformation*

A resistant bacterium may release the resistance carrying DNA into the medium and this may be imbibed by another sensitive organism becoming unresponsive to the drug. This mechanism is probably not clinically significant.

8. MANUFACTURE OF ANTIBIOTICS

Antibiotics may be manufactured by a fermentation process (most antibiotics) by fermentation followed by chemical synthesis (certain penicillin) or by synthesis (chloramphenicol)

Today antibiotics are made by deep (submerged) culture in which the mould is encouraged to grow deeply submerged in a large tank of medium.

8.1 Choice of Organism

The organism should give high Yield of antibiotic from economic sources of nutrients and should not produce excessive amount of substances chemically related to the antibiotic because separation may be difficult.

8.2 Choice of Medium

The basis of most fermentation media is corn steep liquor, the fluid obtained from the steeping of maize prior to starch extraction. It provides a variety of nutrients and has good buffering capacity. For most fermentations, particularly those involving fungi, additional sugar (normally lactose or glucose) is needed as a source of energy for mycellium production. Occasionally, when the nitrogen demand is high. Soyabean , or peanut, meal may be added. Buffering salts may be required when the antibiotic is pH sensitive.

8.3 Cultivation of the Organism

The suspension in the flasks is used to inoculate a 2000 dm^3 tank, known as the seed vessel. This is a small version of the fermenter. After further

incubation, sterile compressed air is used to blow the contents through sterile pipe into huge fermentation tanks (fermenters) with a capacity of 50,000 dm^3 or more. The growth of the mould is allowed to continue until a satisfactory level of antibiotic has been reached.

8.4 Aeration

Because the moulds (usually species of penicillium and Streptomyces) used in antibiotic production are aerobic they will not grow well deep in a tank of medium unless they are supplied with plenty of oxygen. This is achieved by pumping in large volumes of air through an inlet (sparager) at the bottom of the fermenter.

8.5 Sterilization

The culture medium vessels, pipe lines and air must be sterile to prevent contamination by extraneous organisms that might reduce yields and produce unwanted metabolities. In the case of penicillin, penicillinase producing organisms would rapidly destroy the antibiotic.

8.6 Temperature Control

Part of the energy produced by carbohydrate break down during the metabolism of the mould is liberated as heat. This must be controlled because

high temperatures inhibit the mould and destroy the antibiotic. An optimum temperature (about 2424 C for penicillin) is maintained by passing cooling water through coils or a jacket, or simply by running cold water over the surface of the fermenter.

8.7 Isolation of the Product

After fermentation the mycelium is removed by a rotary filter. The antibiotic is obtained from the filtrate by adjustment to a pH at which the acid or base (depending on the nature of the antibiotic) is liberated, followed by removal of unwanted substances and extraction of the active material with a solvent system.

9. TYPE OF ANTIBIOTICS

9.1 Penicillin

Sir Alexander Fleming discovered penicillin in 1928 as first antibiotic. Penicillin, the most important of the antibiotic was first extracted from the mould *Penicillium notatum* subsequently, a mutant of a related mould p. chrysogenum, was found to give the higher yield of penicillin and is now employed for commercial production of this antibiotic. Pencillins belong to a group of

antibiotics called as *Beta lactam* antibiotics; the other members include cephaloporins, cephomycins, monobactams and carbapenems.

9.2 Streptomycin

This antibiotic, obtained from *Streptomyces griseus*, is an organic base which forms water soluble salts. The base and the salts in a dry state are stable at room temperature. The aqueous solution of the salt retains its activity at PH3 to 7 for 3 months. If kept at 28°C or below. Streptomycin is most important in the treatment of tuberculosis caused by gram negative organisms, and for gonorrhoea where, because (unlike penicillin, which is also active against the gonococcus) it has no action against *Theponema pallidum*, it does not obscure concurrent infection with syphilis.

9.3 Tetracycline

Tetracycline antibiotics were discovered as a result of a systematic plan by the American pharmaceutical industry for screening a multitude of soil micro-organism for potential antibiotic activity. The first member chlortetracycline, isolated from *Streptomyces aureofaciens*, was introduced in 1948 This was followed by Oxytetracycline derived from *Streptomyces rimosus* in 1950 and

tetracycline prepared by catalytic hydrogenation of chlortetracycline in 1953 Many other semisynthetic tetracyclines have since been introduced in the therapy

9.4 Chloramphenicol

Compared with most other antibiotics, chloramphenicol has a simple chemical structure and, therefore, was the first antibiotic to be synthesised. Formerly it was obtained from *Streptomyces venezuelae* but now all the Chloramphenical used in this country is synthetic. Although chloramphenical is a broad spectrum antibiotic its use is severely restricted because it damages the haemopoietic system causing agranulocytosis and sometimes fatal aplastic ahaemia. It should not be used for carriers of typhoid, because long treatment may be required. Chloramphenicol acts by interfering with protein synthesis.

9.5 Erythromycin

This is manufactured by growing *Streptomyces erythreus* in deep culture. It is only slightly soluble in water and the three derivatives that are also used in Pharmacy (the estolate, stearate and ethyl carbonate) are almost insoluble.

It is a narrow spectrum antibiotic with activity similar to penicillin and its main use is for treating patients who have penicillin resistant infections or who are allergic to penicillin.

9.6 Cycloserine

Cycloserine is obtained by growing either *streptomyces orchidaceous* or *Streptomyces garyphalous* in submerged culture or, because it has a relatively simple structure by synthesis.

It is water soluble and has a broad spectrum of activity. Its main use is for treating pulmonary tuberculosis caused by strains resistant to streptomycin.

9.7 Viomycin

This antibiotic is used in the form of sulphate and is produced by certain strains of *Streptomycesgrisus var purpurea.* The sulphate is very stable, slightly hygroscopic and very soluble in water. Aqueous solutions have a storage life of one week at room temperature and one month between 2 and 10°C. It is used by intramuscular injection to treat tuberculosis caused by stains resistant to streptomycin.

CONCLUSION

Antibiotics are the greatest contribution of the 20^{th} century to therapeutics. Their advent changed the outlook of the physician about the power drugs can have on diseases. They are one of the few curative drugs. Their importance is magnified

in the developing countries where infective diseases predominate. As a class, they are one of the most frequently used as well s misused drugs.

Today we have two big antibiotic plants of our own, one at Pimpuri (near Poona) and another at Rishikesh and, together these meet more than 90% of our nation's requirement. A private pharmaceutical company is now going into the production of penicillin in India.

CHAPTER-III

OBJECTIVES AND METHODOLOGY OF BIBLIOMETRIC STUDY

Bibliometrics is a quantitative and qualitative study based on statistical and mathematical methods. This study is helpful in management of scientific literature measuring the utility of periodicals and relationship between journals and subject areas and also in knowing the most productive contributors in a given field. Due to interdisciplinary nature of research and trends towards specialization, librarian and information scientists are facing great problem in acquisition, organisation and dissemination of information. Therefore, to eliminate these problems there is a need for such type of study.

1. OBJECTIVES

1 1 To know the most used form of documents.

1.2 To know the language(s) in which the most of literature on the subject has been published

1.3 To know the most productive country

1.4 To identify the scattering of subjects.

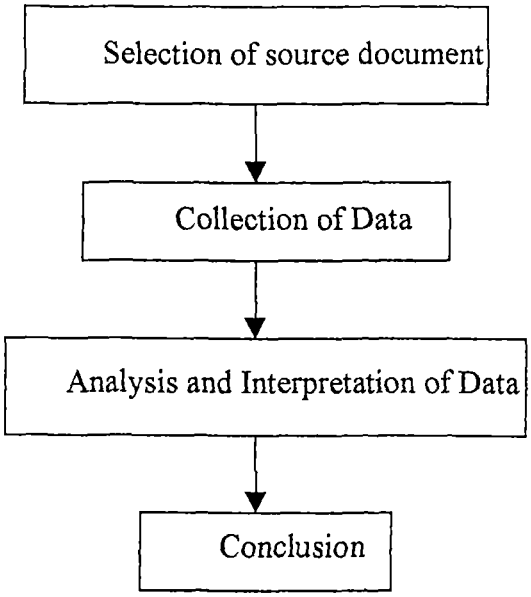
1.5 To prepare a ranked list of journals and to find out the core journals.

1.6 To know the eminent authors in the field of 'Antibiotics'.

1.7 To know the rate of collaborative research.

2 METHODOLOGY OF BIBLIOMETRICS

The methodology of Bibliometrics can be shown through the following flow chart.



2.1 Selection of source documents

The first step in this study is to select the source document from which data is to be collected. For this purpose, *Index Medicus* which is published from MEDLARS (Medical Literature Analysis and Retrieval system), Washington, USA since 1964 has been consulted.

2.2 Collection of data

From the four volumes of *Index Medicus* i.e. from 1996 to 1999, 4,108 references on the subject 'Antibiotics' were collected on 5" x 3" catalogue cards. Each card contained information about author(s), title, name of the periodical, place, year, language and form of document.

2.3 Analysis and Interpretation of data

In this step all the cards were arranged and rearranged in order to complete the following studies :

2.3.1 Ranking of periodicals

2.3.2 Country wise distribution of items

2.3.3 Year wise distribution of items

2.3.4 Language wise distribution of items

2.3.5 Subject wise distribution of items

2.3.6 Form wise distribution of items

2.3.7 Ranking of authors

2.3.8 Application of Bibliometric Laws

2.3.1 Ranking of periodicals

This is to identify the core periodicals containing the research literature on 'Antibiotics'. For this purpose, a ranked list of periodicals was prepared.

2.3.2 Country wise distribution of items

It is done to identify the place of origin of documents which is given in *Index Medicus*. The entries were grouped on the basis of their places of origin. They were then counted and ranked in a table.

2.3.3 Year wise distribution of items

It is useful to know the currency of source documents. This type of study reveals the number of works in a particular year in which most of the study is conducted. For this purpose a table showing year wise distribution has been prepared.

2.3.4 Language wise distribution of items

For the purpose of language wise analysis the entries were grouped according to their language of origin. After this, they were counted and then prepared a ranked list of languages.

2.3.5 Subject wise distribution of items

Though most of the literature on a given subject is published in core journals but sometimes some material of research value is published in the journals belonging to related fields due to the phenomenon of scattering. The information about the subject field of periodicals was obtained from 'Ulrich International Periodicals Directory' (35th ed.). This analysis identifies the core subjects as well as related subjects on 'Antibiotics'.

2.3.6 Form wise distribution

Literature on the subject 'Antibiotics' is published in different forms like books, bulletins, patents, articles, reports etc. The information regarding the form was collected form *Index Medicus*, tabulated to find out the most dominant form of literature.

2.3.7 Ranking of Authors

It is done to know the most productive contributors in the subject. For the purpose of ranking of authors, the information about all the authors was retrieved, arranged and tabulated in the order of decreasing frequency of their contributions.

2.3.8 Application of Bibliometric Laws

The whole study depends upon the application of bibliometric laws such as Lotka, Bradford and Zipf's Laws. These laws were applied to the analyzed data to check validity.

2.4 Conclusion

At the end findings of the study were summarised and concluded.

CHAPTER – IV

DATA ANALYSIS, INTERPRETATION AND REPRESENTATION

Four volumes of *Index Medicus* for the years 1996, 1997, 1998 and 1999 were consulted for collecting required data on the topic 'ANTIBIOTICS'. In all 4,108 items on the subject were collected. The data, was then analyzed as under :

1. COUNTRY WISE DISTRIBUTION

It is a known fact that certain countries give more research output in a particular subject than others. This information is very much useful, not only for the information managers in finalizing the subscription list of periodicals but also for the research scholars as they tend to know the countries which are leaders in the field.

Table – 1 contains a list of 50 countries producing research material on Antibiotics These countries have been ranked on the basis of frequency of occurrence of items. The analysis has revealed that 37 14% of articles were published from U S A. only. This is followed by England and Japan which produce 18 93% and 6.32% research items respectively

The analysis not only shows the most potent countries of research on antibiotics but also indicates the wide coverage of *Index Medicus*, as the publications from as many as 50 countries of the world, have been listed

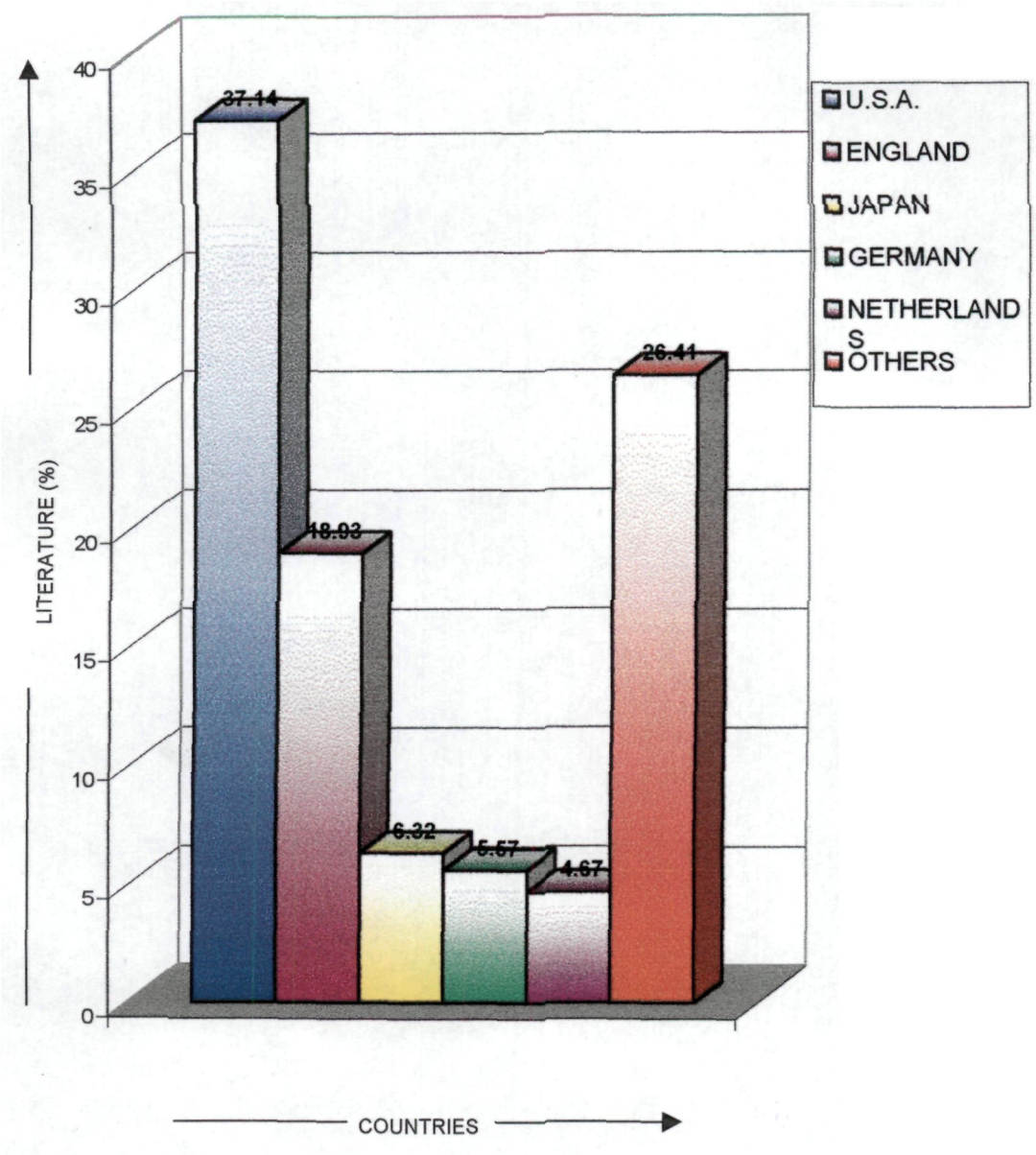
TABLE – 1

Countrywise Distribution of Items

S.No.	Rank	Name of the Country	Frequency of Occurrence	Percentage
1.	1	USA	1526	37 14
2.	2	England	778	18 93
3	3	Japan	260	6 32
4.	4	Germany	229	5 57
5	5	Netherlands	192	4 67
6.	6	Russia	160	3 89
7.	7	France	157	3 82
8.	8	Italy	96	2 33
9.	9	Switzerland	91	2 21
10	10	Canada	75	1.82
11.	11	Spain	70	1 70
12.	12	Denmark	69	1 67
13	13	Norway	58	1 41
14	14	Australia	46	1 11
15	15	Sweden	42	1.02
16	16	New Zealand	34	0.82

17.	17	India	29	0.70
18.	17	Poland	29	0.70
19.	18	Ireland	21	0.51
20.	19	Hungary	16	0.38
21.	20	Czech Republic	14	0.34
22.	21	Romania	12	0.29
23.	22	Belgium	09	0.21
24.	22	Ukraine	09	0.21
25.	23	China	08	0.19
26.	23	South Africa	08	0.19
27.	24	Kenya	07	0.17
28.	24	Mexico	07	0.17
29.	24	Singapore	07	0.17
30.	25	Thailand	05	0.12
31.	26	Bangladesh	04	0.09
32.	26	Greece	04	0.09
33.	27	Brazil	03	0.07
34.	27	Bulgaria	03	0.07
35.	27	Finland	03	0.07
36.	27	Korea	03	0.07
37.	27	Pakistan	03	0.07
38.	27	Taiwan	03	0.07
39.	28	Croatia	02	0.04
40.	28	Israel	02	0.04
41.	28	Jamaica	02	0.04
42.	28	Nigeria	02	0.04
43	28	Portugal	02	0.04
44.	28	Turkey	02	0.04
45.	29	Argentina	01	0.02
46.	29	Austria	01	0.02
47.	29	Scotland	01	0.02
48.	29	Tunisia	01	0.02
49.	29	Venezuela	01	0.02
50.	29	Yugoslavia	01	0.02
		Total	**4108**	**99.04**

DIAGRAM - 1 REPRESENTING COUNTRY WISE LITERARY OUTPUT



2. LANGUAGE WISE DISTRIBUTION

The main objective of this study is to find out the most dominant language or languages in which the literature on the subject 'Antibiotics' is being produced. Language plays a significant role in the exchange of scientific information. Information about the most dominant language is very much useful for the librarians in the acquisition of periodicals and provision of translation services to the users.

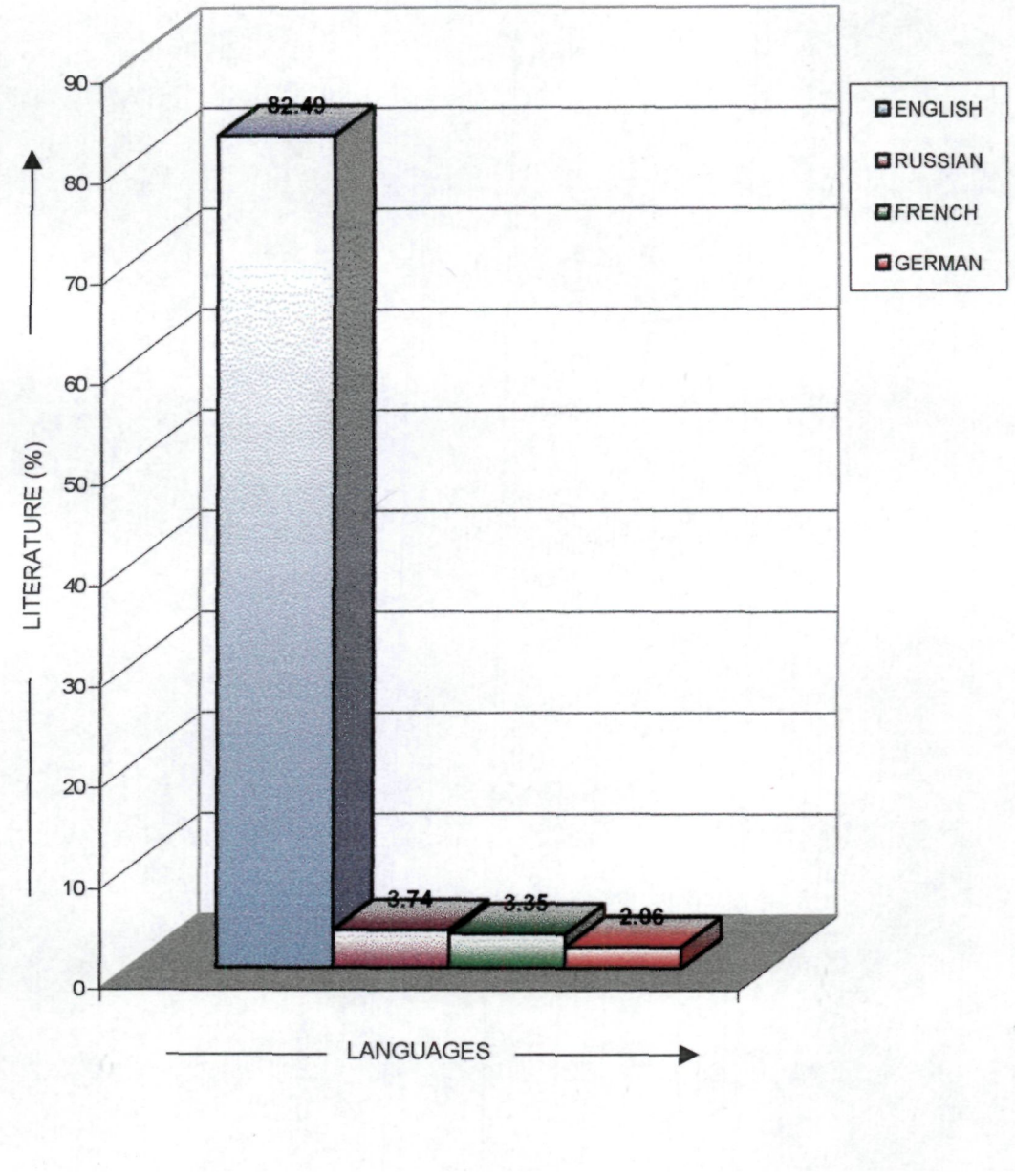
Table-2 shows that the total number of items (4,108) were published in 23 different languages, out of which, English was found to be the most dominant language, as 3389 items constituting 82.49% were reported to be published in that language. The second position is occupied by Russian literature, in which 154 items constituting 3.74% were reported in four volumes of *Index Medicus*. The third, fourth and fifth positions were occupied by, French (3.35%), German (2.06%) and Spanish (1.87%). About 8.40% of the total literature on Antibiotics is being published in other languages. Thus, the most dominant language of scientific communication on Antibiotics is found to be English, followed by Russian, French, German and Spanish languages.

TABLE – 2

Languagewise Distribution of Items

S.No.	Rank	Name of Language	Frequency Occurrence	Frequency Percentage	Cumulative Frequency (%)
1	1	English	3389	82 49	82 49
2	2	Russian	154	3 74	86 23
3	3	French	138	3 35	89 58
4	4	German	85	2 06	91 64
5	5	Spanish	77	1 87	93 51
6	6	Japanese	71	1 72	95 23
7	7	Dutch	46	1 11	96 34
8	8	Swedish	24	0 58	96 92
9	8	Danish	24	0 58	97 50
10	9	Polish	18	0 43	97 93
11	10	Italian	16	0 38	98 31
12	11	Norwegian	12	0 29	98 60
13	12	Hungarian	10	0 24	98 84
14	12	Romanian	10	0 24	99 08
15	13	Ukrainian	09	0 21	99 29
16	14	Chinese	06	0 14	99 43
17	15	Czech	05	0 12	99 55
18	16	Roman	04	0 09	99 64
19	17	Hebrew	03	0 07	99 71
20	18	Bulgarian	02	0 04	99 75
21	18	Portuguese	02	0 04	99 79
22	18	Slovak	02	0 04	99 83
23	19	Finnish	01	0 02	99 85
		Total	**4108**	**99.85**	

DIAGRAM - 2 LANGUAGEWISE DISTRIBUTION OF ITEMS



3. YEAR WISE DISTRIBUTION

Currency of information is an important factor for any good Indexing service. The main objective of the chronological study is to find out current information published by *Index Medicus*. This study is too much useful in knowing the currency of information and also in knowing the most productive year of items ranked. Through this study, we know that how many articles were published in which year.

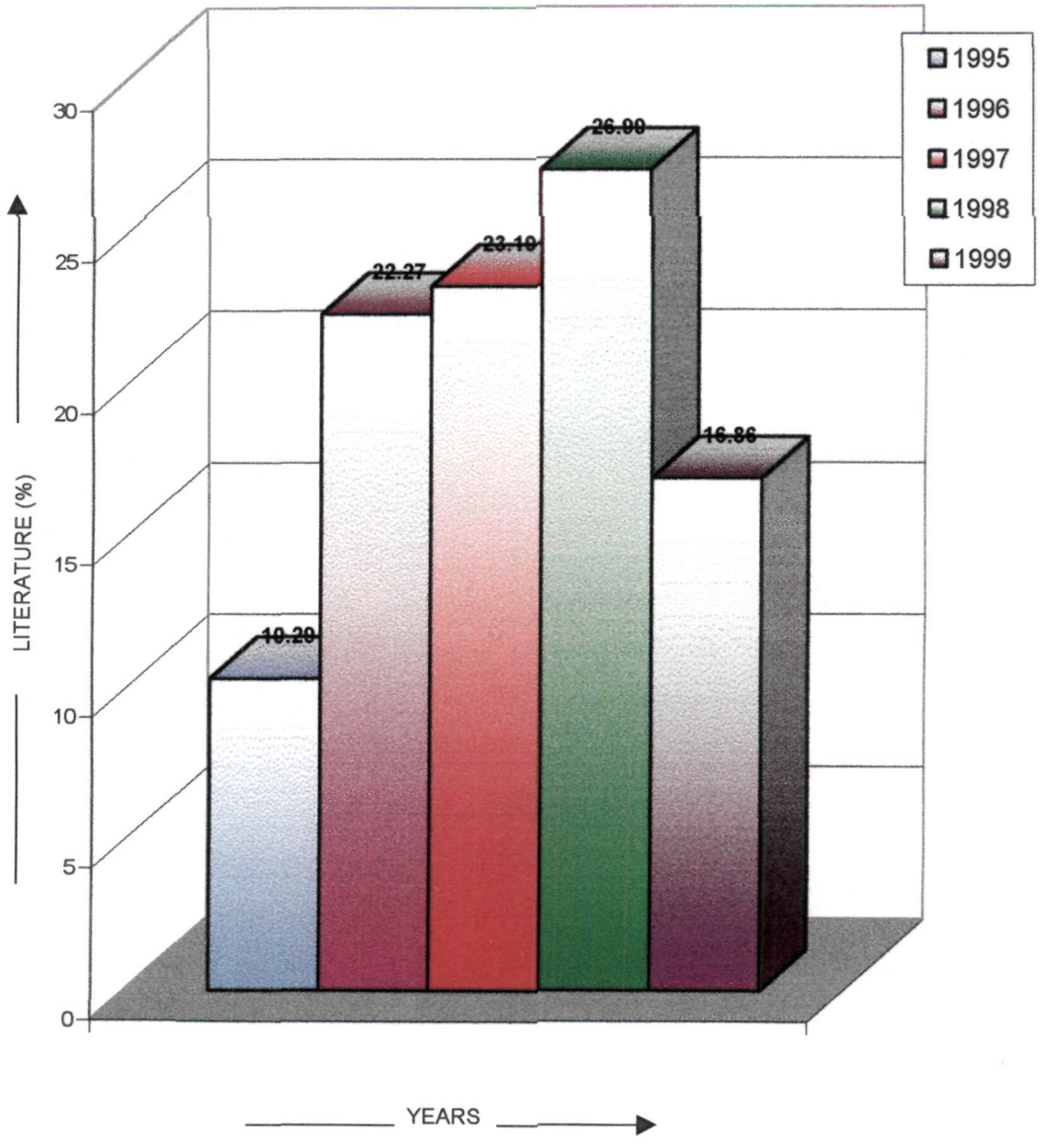
Table-3 shows the chronological scattering of all references. It gives the number of items published in the volumes of 1996-99 in *Index Medicus* in different years. It is to be observed that the frequency of occurrence of items in the volume of 1998 was the highest i.e. 1109 for the same year and that of 1997 the frequency of occurrence was 953 which was again the highest for the year. However, the total percentage of the frequency of occurrence of itmes in the volume of *Index Medicus* was the highest i.e. 26.99% in 1998. This is followed by 1997 and 1996 with a total percentage of frequency of occurrence as 23.19% and 22.27% respectively. For the year 1999 and 1995 the total percentage of frequency of occurrence is 16.86% and 10.29% respectively.

TABLE – 3

Yearwise Distribution of Items

S.No.	Period of Origin	Frequency of Occurrence				Total Frequency of Occurrence	Percentage Frequency of Occurrence	Cumulative Percentage Frequency
		Vol. *96*	Vol. *97*	Vol. *98*	Vol. *99*			
1.	1993	-	-	-	-	-	-	-
2.	1994	15	-	-	-	15	0.36	0.36
3.	1995	423	-	-	-	423	10.29	10.65
4.	1996	875	40	-	-	915	22.27	32.96
5.	1997	-	928	21	04	953	23.19	56.11
6.	1998	-	-	1096	13	1109	26.99	83.10
7.	1999	-	-	-	693	693	16.86	99.96
	Total	**1313**	**968**	**1117**	**710**	**4108**	**99.96**	

DIAGRAM - 3 YEARWISE DISTRIBUTION OF ITEMS



4. FORM WISE DISTRIBUTION

Information is available in a variety of forms namely Articles, Letters, News etc. The main objective of this study is to find out most used form of source material It will help the information scientists and their users to know the most dominant forms of documents in which information is being produced on the subject.

Table-4 gives the formwise distribution of items. It was found from the analysis that periodical articles are the most dominant form in which scientific information is communicated in Antibiotics. It is obvious from the fact that 92.74% literature on the subject appeared in form of periodical articles, letters and news items constitute 5.55% and 1.02% respectively.

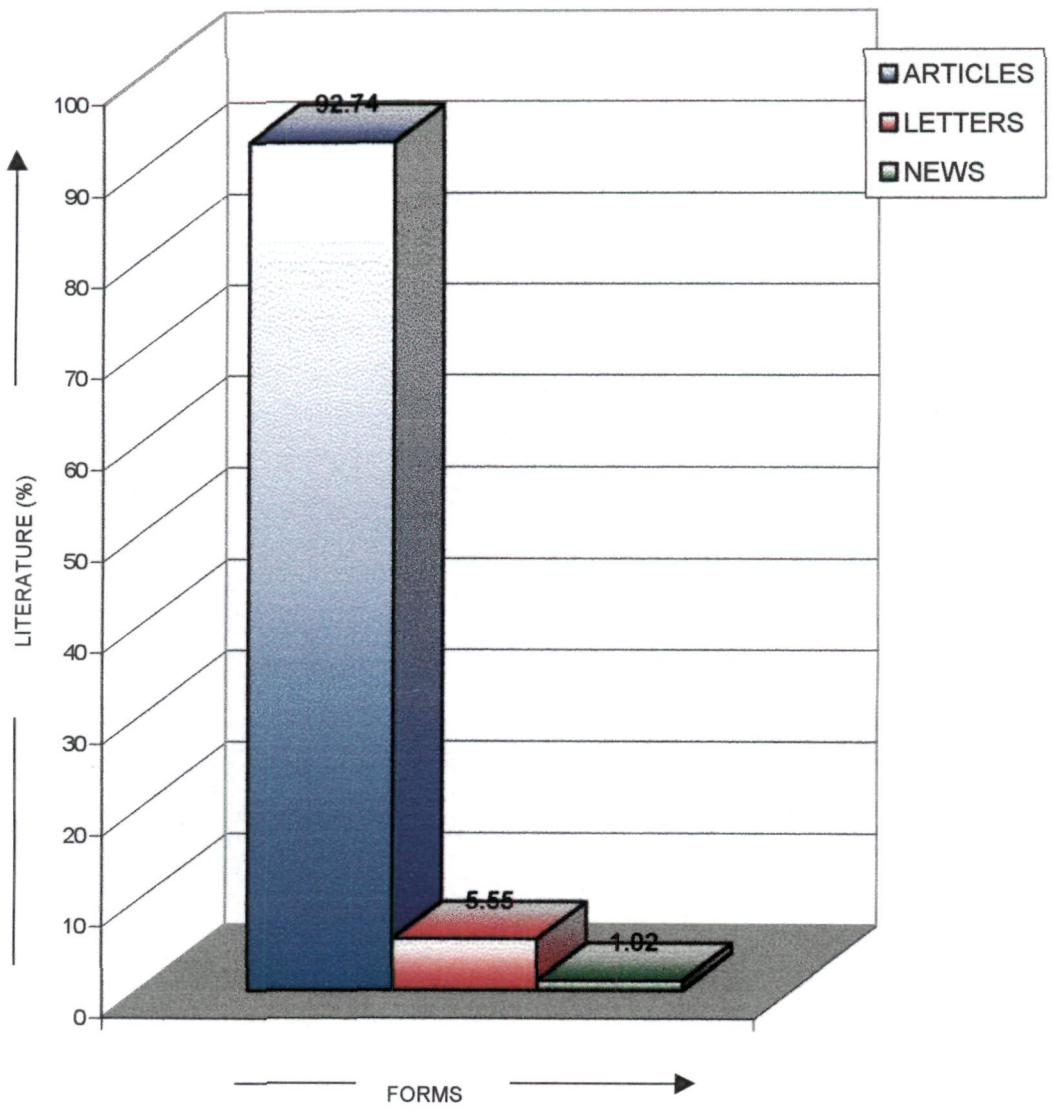
This analysis may help the information scientist to decide as to which form of documents, he has to procure in the library to meet the information requirements of the researchers in the field of Antibiotics.

TABLE – 4

Formwise Distribution of Items

S. No.	Name of the Form	Frequency Occurrence	Frequency Percentage	Cumulative Percentage
1.	Articles	3810	92.74	92.74
2.	Letters	228	5.55	98.28
3.	News	42	1 02	99.31
4.	Conference Proceedings	28	0.68	99.99
	Total	**4108**	**99.99**	

DIAGRAM - 4 FORMWISE DISTRIBUTION OF ITEMS



5. RANKING OF PERIODICALS

Periodicals are the sources of current information. They play a vital role in scientific communication. In every subject there are certain core journals producing most of the literature. Identification of core journals in the subject under study will be useful from the point of view of scientists and librarians alike.

The main aim of the present study is to identify, the most important journals containing the most of the literature of research value in the field of Antibiotic. This information will go a long way in preparing a subscription list of periodicals. This information is useful for the information scientists as well as they know the names of core journals in their own field.

In the collected data, all the 4,108 references have been published in 532 periodicals, which have been, ranked upto 43 positions. However, the Table-5 lists only 265 periodicals, showing 40 rank positions. There are periodicals in which the frequency of occurrence of items is upto 4. The periodicals with less than 4 items have not been considered. Table-5 shows that the first rank was occupied by the journal, titled journal of '**Antimicrobial Chemotherapy**', which accounts for 4.25% of total references. Next three positions are occupied by '**Journal of Antibiotics**' (4.18%), '**Antimicrobial Agents and Chemotherapy**' (3.99%) and '**Clinical Infectious Diseases**' (2.48%) respectively.

TABLE – 5

Ranking of Periodicals

S No	Rank	Name of Periodical	Country	Frequency	%Age
01	1	Journal of Antimicrobial Chemotherapy	England	175	4 25
02	2	Journal of Antibiotics	Japan	172	4 18
03	3	Antimicrobial Agents and Chemotherapy	USA	164	3 99
04	4	Clinical Infectious Diseases	USA	102	2 48
05	5	Antibiotiki I Khimioterapia	Russia	74	1 80
06	5	BMJ	England	74	1 80
07	6	Lancet	England	71	1 72
08	7	Japanese Journal of Antibiotics	Japan	62	1 50
09	8	Journal of Chemotherapy	Italy	57	1 38
10	9	Diagnostic Microbiology and Infectious Disease	USA	50	1 21
11	10	Pediatrics Infectious Disease Journal	USA	46	1 11
12	11	European Journal of Clinical Microbiology and Infectious Diseases	Germany	44	1 07
13	12	New England Journal of Medicine	USA	43	1 04
14	13	Journal of the American Medical Association (JAMA)	USA	42	1 02
15	14	Infectious Disease Clinics of North America	USA	40	0 97
16	15	Nederlands Tijdschrift voor Geneeskunde	Netherlands	36	0 87
17	15	Presse Medical	France	36	0 87
18	16	Chemotherapy	Switzerland	32	0 77
19	16	International Journal of Antimicrobial Agents	Netherlands	32	0 77
20	16	Journal of Bacteriology	USA	32	0 77
21	17	Journal of Family Practice	USA	31	0 75
22	18	Veterinary Record	England	27	0 60
23	19	Ugeskrift For Laeger	Denmark	25	0 60
24	20	Journal of Infection	England	24	0 58
25	20	Lakartidningen	Sweden	24	0 58
26	21	Infection Control and Hospital Epidermiology	USA	23	0 55
27	22	Annals of Pharmacotherapy	USA	22	0 53
28	22	Chest	USA	22	0 53
29	23	American Journal of Medicine	USA	21	0 51
30	23	Journal of Dairy Science	USA	21	0 51
31	24	Enfermedades Infecciosas Y Microbiologia Clinica	Spain	20	0 48
32	24	Journal of the American Veterinary Medical Association	USA	20	0 48
33	24	Journal of Clinical Microbiology	USA	20	0 48
34	25	American Journal of Health-system Pharmacy	USA	19	0 46
35	26	Drugs	New Zeland	18	0 43
36	26	Pediatrics	USA	18	0 43
37	27	Journal of Clinical Microbiology	USA	17	0 41
38	28	Applied and Environmental Microbiology	USA	16	0 38

39	28	CMAJ	Canada	16	0.38
40	28	Journal of AOAC International	USA	16	0.38
41	29	American Family Physician	USA	15	0.36
42	29	Journal of Chematography.A	Netherlands	15	0.36
43	30	Journal of Infectious Diseases	USA	14	0.34
44	31	Advances in Experimental Medicine and Biology	USA	13	0.31
45	31	Annals of Internal Medicine	USA	13	0.31
46	31	Archives De Pediatrie	France	13	0.31
47	31	British Journal of General Practice	England	13	0.31
48	31	FEMS Microbiology letters	Netherlands	13	0.31
49	31	Infection	Germany	13	0.31
50	31	Journal of Hospital Infection	England	13	0.31
51	31	Journal of Natural Products	USA	13	0.31
52	31	Microbiology	England	13	0.31
53	31	Pathologie Biologie	France	13	0.31
54	31	Pharmacotherapy	USA	13	0.31
55	31	Scandianvian Journal of Gastroentherology. Supplement	Norway	13	0.31
56	32	American Journal of Gastroenterology	USA	12	0.29
57	32	Archives of Family Medicine	USA	12	0.29
58	32	Archives of Internal Medicine	USA	12	0.29
59	32	European Journal of Surgery. Supplement	Norway	12	0.29
60	32	Journal of Applied Microbiology	England	12	0.29
61	32	Journal of Veterinary Pharmacology and Therapeutics	England	12	0.29
62	32	Letters in Applied Microbiology	England	12	0.29
63	32	Medicine Clinica	Spain	12	0.29
64	32	Tidsskrift for Den Norske Laegeforening	Norway	12	0.29
65	33	American Joural of Obstetrics and Gynaecology	USA	11	0.26
66	33	American Journal of Veterinary Research	USA	11	0.26
67	33	Canadian Veterinary Journal	Canada	11	0.26
68	33	Journal of Chromatography. B,	Germany	11	0.26
69	33	Kansenshogaku Zasshi	Japan	Ii	0.26
70	33	Pediatric Annals	USA	11	0.26
71	33	Postgraduate Medicine	USA	11	0.26
72	33	Scandianavian Journal of Infectious Diseases	Sweden	11	0.26
73	33	Zentralblatt Fur Veterinarmedizin Reihe.B	Germany	11	0.26
74	34	Australian Family Physician	Australia	10	0.24
75	34	Biotechnology	USA	10	0.24
76	34	British Journal of Clinical Pharmacology	England	10	0.24
77	34	Critical Care Medicine	USA	10	0.24
78	34	European Respiratory Journal	Denmark	10	0.24
79	34	Fortschritte Der Medizin	Germany	10	0.24
80	34	Journal of Biological Chemistry	USA	10	0.24
81	34	Microbios	Eng;amd	10	0.24
82	34	Tijdschrift Voor Diergeneesku	Netherlands	10	0.24
83	35	American Journal of Infection Control	USA	9	0.21
84	35	Atencion Primaria	Spain	9	0.21

85	35	Australian and New Zeland Journal of Surgery	Australia	9	0 21
86	35	Clinical Pediatrics	USA	9	0 21
87	35	DTW Deutsche Tierarztliche Wochenschrift	Germany	9	0 21
88	35	Epidemiology and Infection	England	9	0 21
89	35	Journal of Ethnopharmacology	Ireland	9	0 21
90	35	Journal of Medical Microbiology	England	9	0 21
91	35	Journal of Trauma	USA	9	0 21
92	35	Klinicheskaia Meditsina	Russia	9	0 21
93	35	Medical Journal of Australia	Australia	9	0 21
94	35	Microbial Drug Resistance	USA	9	0 21
95	35	Social Science and Medicine	England	9	0 21
96	35	Thorax	England	9	0 21
97	36	Bacteriologia,Virusologia Parazitologia Epidermiolgia	Romania	8	0 19
98	36	Bioorganic and Medicinal Chemistry	England	8	0 19
99	36	British Journal of Ophthalmology	England	8	0 19
100	36	Canadian Family Physician	Canada	8	0 19
101	36	Canadian Journal of Gastroenterology	Canada	8	0 19
102	36	Comprehensive Therapy	USA	8	0 19
103	36	Gastroenterology	USA	8	0 19
104	36	Hospital Practice	USA	8	0 19
105	36	Journal of Clinical Epidemiology	England	8	0 19
106	36	Journal of Emergency Medicine	USA	8	0 19
107	36	Journal of Periodontology	USA	9	0 19
108	36	Respiratory Medicine	England	8	0 19
109	36	Science	USA	8	0 19
110	36	Tropical Medicine and International Health	England	8	0 19
111	36	Vestnik Otorinolaringologu	Russia	8	0 19
112	36	Zentralblatt Fur Bakteriologie	Germany	8	0 19
113	37	Acta Paediatrica Japonica	Australia	7	0 17
114	37	American Journal of Ophthalmology	USA	7	0 17
115	37	Archives of Surgery	USA	7	0 17
116	37	Arzneimittel Forschung	Germany	7	0 17
117	37	Berliner Und Munchener Tierarztliche Wohenschrift	Germany	7	0 17
118	37	Biochemical and Biophysical Research Communication	USA	7	0 17
119	37	British Journal of Surgery	England	7	0 17
120	37	Chemical and Pharmaceutical Bulletin	Japan	7	0 17
121	37	Connecticut Medicine	USA	7	0 17
122	37	Dermatology	Switzerland	7	0 17
123	37	East Africa Medical Journal	Kenya	7	0 17
124	37	European Journal of Gastroenterology and Hepatology	England	7	0 17
125	37	Food Additives and Contaminants	England	7	0 17
126	37	Journal of Veterinary Medical Science	Japan	7	0 17
127	37	Pediatric Pulmonology Supplement	USA	7	0 17
128	37	Pharmacy world and science	Netherlands	7	0 17

129	37	Pharmazie	Germany	7	0.17
130	37	Seminars in Respiratory Infections	USA	7	0.17
131	37	Veterinary Microbiology	Netherlands	7	0.17
132	38	American Journal of Respiratory and critical care Medicine	USA	6	0.14
133	38	Annals of the Acadmy of Medicine, Singapore	Singapore	6	0.14
134	38	Archives of Ophthalmology	USA	6	0.14
135	38	British Dental Journal	England	6	0.14
136	38	Chemistry and Biology	England	6	0.14
137	38	Contact Dermatitis	Denmark	6	0.14
138	38	Ear,Nose and Throat Journal	USA	6	0.14
139	38	Emerging Infectious Diseases	USA	6	0.14
140	38	Family Practice	England	6	0.14
141	38	Gene	Netherlands	6	0.14
142	38	Indian Pediatrics	India	6	0.14
143	38	Intensive Care Medicine	USA	6	0.14
144	38	Irish Journal of Medical Science	Ireland	6	0.14
145	38	J ournal of Clinical Gastroenterology	USA	6	0.14
146	38	Journal of Clinical Pharmacy and Therapeutics	USA	6	0.14
147	38	Journal of Medicinal Chemistry	USA	6	0.14
148	38	Journal of Small Animal Practice	England	6	0.14
149	38	Molecular Mirobiology	England	6	0.14
150	38	National Medical Journal of India	India	6	0.14
151	38	Orvosi Hetilap	Hungary	6	0.14
152	38	Pathology	USA	6	0.14
153	38	Retina	USA	6	0.14
154	38	Revista Clinica	Spain	6	0.14
155	38	Sandeinavian Journal of Primary Health Care	Norway	6	0.14
156	38	Schweizerische Rundschau Fur Medizin Praxis	Germany	6	0.14
157	38	Supportive Care in Cancer	Germany	6	0.14
158	39	American Journal of Surgery	USA	5	0.12
159	39	Analytical Chemistry	USA	5	0.12
160	39	Archives of Dermatology	USA	5	0.12
161	39	Australian Veterinary Journal	Australia	5	0.12
162	39	Biochemistry	USA	5	0.12
163	39	Biomerials	England	5	0.12
164	39	British Journal of Haematology	England	5	0.12
165	39	British Journal of Obstetrics and Gynaecology	England	5	0.12
166	39	Canadian Journal of Microbiology	Canada	5	0.12
167	39	Cancer Investigation	USA	5	0.12
168	39	Clinical Orthopaedics and Related Research	USA	5	0.12
169	39	Clinical Otolaryngology	England	5	0.12
170	39	Clinical Pharmacokinetics	Newzeland	5	0.12
171	39	Current Clinical topics in Infectious diseases	England	5	0.12
172	39	Current Opinion in Pulmonary Medicine	USA	5	0.12
173	39	European Journal of Surgery	Norway	5	0.12
174	39	Folia Microbiologica	Czech Republic	5	0.12
175	39	Infectious Diseases in Obstetrics and Gynaecology	USA	5	0.12

176	39	International Journal of Clinical Practice	England	5	0.12
177	39	International Journal of Epidermiology	England	5	0.12
178	39	Journal of the American Academy of Dermatology	USA	5	0.12
179	39	Journal of Animal Science	USA	5	0.12
180	39	Journal of Food Protection	USA	5	0.12
181	39	Journal of General Internal Medicine	USA	5	0.12
182	39	Journal of Pediatrics	USA	5	0.12
183	39	Journal of Pharmacy and Pharmacology	England	5	0.12
184	39	Journal of Veterinary Diagnostic	USA	5	0.12
185	39	Khirurgiia	Russia	5	0.12
186	39	Microbiology and Immunology	Japan	5	0.12
187	39	Natural Biotechnology	USA	5	0.12
188	39	Natural Product Reports	England	5	0.12
189	39	Nephrology, Dialysis, Transplantation	England	5	0.12
190	39	New Zealand Medical Journa	New Zeland	5	0.12
191	39	Ophthalmology	USA	5	0.12
192	39	Pediatric Pulmonology	USA	5	0.12
193	39	Research in Veterinary Science	England	5	0.12
194	39	Scandinavian Journal of Infectious Disease Supplementum	Sweden	5	0.12
195	39	Sexually Transmitted Diseases	USA	5	0.12
196	39	South African Medical Journal	South Africa	5	0.12
197	39	Sourth East Asian Journal of Tropical Medicine and Public Health	Thailand	5	0.12
198	39	Southern Medical Journal	USA	5	0.12
199	39	Steriods	USA	5	0.12
200	39	Stomatologiia	Russia	5	0.12
201	39	Terapevtichespi Arkhiv	Russia	5	0.12
202	39	Western Journal of Medicine	USA	5	0.12
203	40	Acta Clinica Belgica	Belgium	4	0.09
204	40	Acta Ophthalmologica Scandinavica	Denmark	4	0.09
205	40	Acta Pp;pmoae Pharmaceutica	Poland	4	0.09
206	40	Acta Veterinaria Hungarica	Hungary	4	0.09
207	40	Acta Veterinaria Scandinavica	Denmark	4	0.09
208	40	AIDS	USA	4	0.09
209	40	American Journal of Emergency Medicine	USA	4	0.09
210	40	American Journal of Kidney Diseases	USA	4	0.09
211	40	American Journal of the Medical Sciences	USA	4	0.09
212	40	American Surgeon	USA	4	0.09
213	40	Annals of Thoracic Surgery	USA	4	0.09
214	40	Applied Biochemistry and Biotechnology	USA	4	0.09
215	40	ASAIO Journal	USA	4	0.09
216	40	Biochemistry and Cell Biology	Canada	4	0.09
217	40	Biomedical Chromatography	England	4	0.09
218	40	Bioscience, Biotechnology and Biochemistry	England	4	0.09
219	40	Bone Marrow Transplantation	England	4	0.09
220	40	Canadian Respiratory Journal	Canada	4	0.09
221	40	Childs Nervous System	Japan	4	0.09

222	40	Circulation	USA	4	0.09
223	40	Clinical and Experimental Allergy	England	4	0.09
224	40	Clinical Microbiology Reviews	USA	4	0.09
225	40	Clinical Obstetrics and Gynecology	USA	4	0.09
226	40	Clinical Therapeutics	USA	4	0.09
227	40	Critical Care Clinics	USA	4	0.09
228	40	Cytometry	USA	4	0.09
229	40	Diabetes Care	USA	4	0.09
230	40	Digestion	Switzerland	4	0.09
231	40	Digestive Diseases	Switzerland	4	0.09
232	40	European Journal of Ophthalmology	Italy	4	0.09
233	40	European Journal of Pediatrics	Germany	4	0.09
234	40	FEBS Letters	Netherlands	4	0.09
235	40	FEMS Immunology and Medical Microbiology	Netherlands	4	0.09
236	40	Genetika	Russia	4	0.09
237	40	Hindustan Antibiotics Bulletin	India	4	0.09
238	40	Human and Experimental Toxicology	England	4	0.09
239	40	International Journal of Dermatology	USA	4	0.09
240	40	International Journal of Immunokharmacology	England	4	0.09
241	40	International Journal of STD and AIDS	England	4	0.09
242	40	Italian Journal of Gastroenterology and Hepatology	Italy	4	0.09
243	40	Journal of Accident and Emergency Medicine	England	4	0.09
244	40	Journal of Clinical Periodntology	Denmark	4	0.09
245	40	Journal of Diarrhaeal Diseases Research	Bangladesh	4	0.09
246	40	Journal of Urology	USA	4	0.09
247	40	Laboratory Animals Sciences	USA	4	0.09
248	40	Laryngoscope	USA	4	0.09
249	40	Medizinische Klinik	Germany	4	0.09
250	40	Military Medicine	USA	4	0.09
251	40	Monaldi Archives For Chest Disease	Italy	4	0.09
252	40	Mycopathologia	Netherlands	4	0.09
253	40	Nature	England	4	0.09
254	40	Nutrition	USA	4	0.09
255	40	Obstetrics and Gynecology	USA	4	0.09
256	40	Pancreas	USA	4	0.09
257	40	Pneumologie	Germany	4	0.09
258	40	Research in Microbiology	France	4	0.09
259	40	Scandianavian Journal of Gastroentherology	Norway	4	0.09
260	40	Schweizer Archiv Fur Tierheilkunde	Sweden	4	0.09
261	40	Schweizerische Medizinische Wochenschrift	Sweden	4	0.09
262	40	South Dakota Journal of Medicine	USA	4	0.09
263	40	Therapie	England	4	0.09
264	40	Trends in Microbiology	USA	4	0.09
265	40	Tropical Doctor	England	4	0.09

Table – 5.1 indicates the range of frequency of occurrence of items. Four periodicals have their range of frequency occurrence more than 100 times and total number of items published are 613 (14.92%). The periodicals having their frequency occurrence in range of 70 – 99 are 3 and the number of items published are 219 (5.33%). In the third range of 50-69 are 3 journals and the No. of items are 169 (4.11%). In the fourth range 35 – 49 covers 7 journals publishing a total of 287 items (6.98%). In the fifth range of 25 – 34, are 6 journals, publishing in all 179 items (4.35%). In the sixth range of 15 – 24, are 19 journals and the number of items published are 367 (8.93%). In the seventh range of 10 – 14 are 40 journals and the number of items reported are 467 (11.36%). The eighth range of 4 – 9 are 183 journals and the number of reported items are 994 (24.19%). The last range of 1 – 4 covers 267 journal and the number of published items is 813 forming 19.79% of the total.

TABLE 5.1
Showing Range of Frequency

S.No.	Frequency Range	No. of Periodicals	No. of Items	Percentage	Cumulative Percentage
1.	100	4	613	14.92	14.92
2.	70 – 99	3	219	5.33	20.25
3.	50 – 69	3	169	4.11	24.36
4.	35 – 49	7	287	6.98	31.34
5.	25 – 34	6	179	4.35	35.69
6.	15 – 24	19	367	8.93	44.62
7.	10 – 14	40	467	11.36	55.98
8.	4 – 9	183	994	24.19	80.17
9.	1 – 3	267	813	19.79	99.96
	Total	**532**	**4108**	**99.96**	

6. SUBJECT WISE DISTRIBUTION

Usually, the information on a given subject is published in the journals belonging to the same subject. But some times some of the vital information gets scattered in some related disciplines of the subject. This phenomenon is called scattering. The present analysis has been done to know the scattering of literature of Antibiotics in other subject fields. Ulrich International Periodicals Directory 35th ed. was consulted to determine the subject field of periodicals. Out of a total of 532 periodicals, 24 periodicals could not be traced in the directory and therefore, have been put under the category unknown.

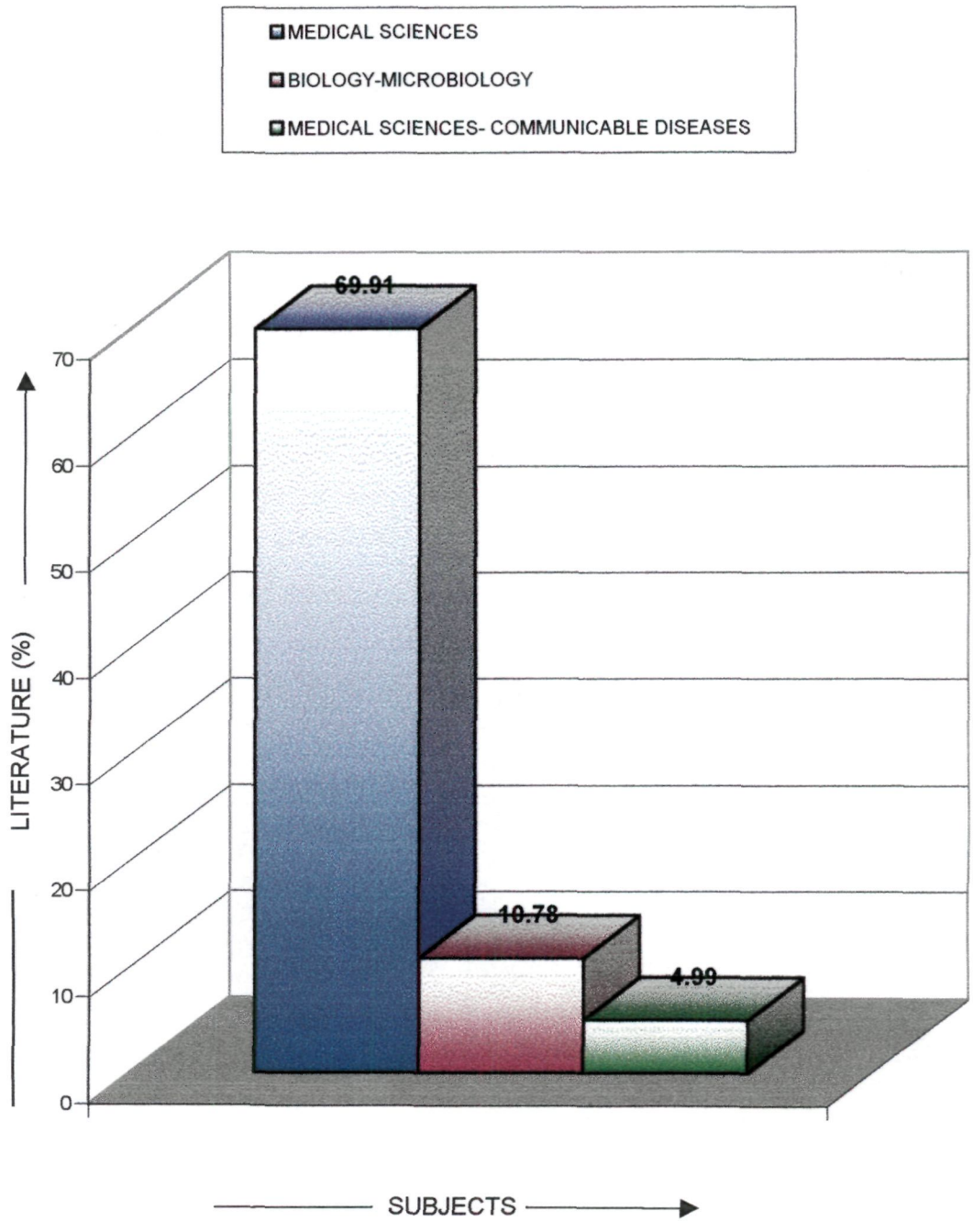
It is observed from table 5 that all the collected items belong to 21 different subject areas which has been ranked from 1 to 14 on the basis of frequency of occurrence of articles. The analysis shows that 69.91% of the literature belongs to '**Medical Sciences**', 10.78% belongs to '**Biology-Microbiology**', 4.99% belongs to '**Medical Science – Communicable Diseases**' respectively.

TABLE – 6

Subjectwise Distribution of Items

S.No.	Rank	Subject Area	Frequency Occurrence	Percentage	Cumulative Percentage
1.	1	Medical Sciences	2872	69.91	69.91
2.	2	Biology – Microbiology	443	10.78	80.69
3.	3	Medical Sciences – Communicable Diseases	205	4.99	85.68
4.	4	Pharmacy and Pharmacology	196	4.77	90.45
5.	5	Medical Sciences – Pediatrics	102	2.48	92.93
6.	6	Medical Sciences – Gastroeterology	96	2.33	95.26
7.	7	Veterinary Science	54	1.31	96.57
8.	8	Medical Sciences – Respiratory Diseases	42	1.02	97.59
9.	9	Medical Sciences – Surgery	30	0.73	98.32
10.	10	Medical Sciences – Obstetrics and Gynecology	12	0.29	98.61
11.	11	Biology	08	0.19	98.80
12	11	Medical Sceiences – Cardiovascular Dieseases	08	0.19	98.99
13.	12	Medical Sciences – Dermatology & Venereology	03	0.07	99.06
14.	12	Chemistry – Analytical Chemistry	03	0.07	99.13
15.	13	Agriculture– Dairying and Dairy Products	02	0.04	99.17
16.	13	Medical Sciences – Cancer	02	0.04	99.21
17.	13	Medical Sciences – Endocrinology	02	0.04	99.25
18.	14	Medical Sciences – Otorhinolaryngology	01	0.02	99.27
19.	14	Medical Sciences – Ophthalmology and Optometry	01	0.02	99.29
20.	14	Medical Sciences – Hematology	01	0.02	99.31
21.	14	Medical Sciences – Experimental, Medicine, Laboratory Technique	01	0.02	99.33
22.	15	Unknown	24	0.58	99.91
		Total	**4108**	**99.91**	

DIAGRAM - 5 SUBJECTWISE DISTRIBUTION OF ITEMS



7. RANKING OF AUTHORS

In any field, certain authors are more eminent than others. Therefore, it is important to know such scientists in the field of 'Antibiotics'. This information is useful for the librarians as well as the users. The names of authors along with the number of their contributions are given in Table-7.

From the analysis it was found that 1552 (37.77%) items were written by single author and 2556 (62.22%) items were written by multiple authors i.e. more than one. It may be noted that names for multiple authors were not given for each item in *Index Medicus*. It shows the present trend of research in which joint efforts are involved to complete a research work.

From a limited sample such as this, it is difficult to name major contributors in the field. However, the present ranking list may be of considerable help to know the names of significant authors in 'Antibiotics'. The names of first three most productive authors are:

i) Chang, JC (10)

ii) Stewart, JT (9)

iii) Telley, CR (8)

TABLE - 7

Ranking of Authors

S.No.	Rank	Name of Author	Frequency
1	1	Chang, JC	10
2	2	Stewart, JT	9
3	3	Telley, CR	8
4	4	Allen, LV	7
5	4	Kepple, SR	7
6	4	White, LL	7
7	5	Dever, LL	6
8	5	Rapp, RP	6
9	6	Bernardini, J	5
10	6	Dunn, SR	5
11	6	Fepete, T	5
12	6	Southern,PM	5
13	6	Thornsberry, C	5
14	6	Watanakunakorn, C	5
15	7	Anaissie, EJ	4
16	7	Bent, S	4
17	7	Bloom, BS	4
18	7	Cohen, FL	4
19	7	Cox, SM	4
20	7	Gibbs, RS	4
21	7	Hoffman – terry, ML	4
22	7	Hussein, AM	4
23	7	Jacobs, MR	4
24	7	Lettich, H	4
25	7	Mecer, BM	4
26	7	Mylotte, JM	4
27	7	Poole, MD	4
28	7	Rifenburg, RP	4
29	7	Tenover, FC	4
30	7	Vogel, F	4
31	7	Yu, YR	4
32	8	Agluilar, HF	3
33	8	Bilik, R	3
34	8	Bonten, MJ	3
35	8	Chaknis, MJ	3
36	8	Cimolai, N	3

37	8	Davis, JL	3
38	8	Ednie, LM	3
39	8	Egarter, C	3
40	8	Fry, DE	3
41	8	Gonzales, R	3
42	8	Hofiman, MF	3
43	8	Jacques, LB	3
44	8	Kunimoto, DY	3
45	8	Han, DP	3
46	8	Lynch, JP	3
47	8	Lacy, JB	3
48	8	Marwick, V	3
49	8	Nathens, AB	3
50	8	Niederman, MS	3
51	8	Nyquest, AC	3
52	8	Paradise, JL	3
53	8	Rello, J	3
54	8	Rhame, FS	3
55	8	Rosenfield, RM	3
56	8	Schentag, JJ	3
57	8	Schwartz, B	3
58	8	Seehusen, DA	3
59	8	Sobragues, M	3
60	8	Soll, AH	3
61	8	Soxena, R	3
62	8	Sorberg, M	3
63	8	Suter, TM	3
64	8	Tateda, K	3
65	8	Trafny, EA	3
66	8	Tropnell, CB	3
67	8	Trexler, ME	3
68	8	Tropnell, CB	3
69	8	Tucci, A	3
70	8	Utrup, LJ	3
71	8	Van Langevelde, P	3
72	8	Vipenes, K	3
73	8	Waldrop, RD	3
74	8	Watanabe, Y	3
75	8	Wellbery, C	3
76	8	Wellman, N	3
77	8	Williams, DL	3
78	8	Wiss, K	3

79	8	Wittmann, DH	3
80	8	Woolf, SH	3
81	8	Witkamp, RF	3
82	8	Zonten, S	3
83	8	Zhao, O	3
84	9	Abadi, FJ	2
85	9	Drobot, GR	2
86	9	Gillum, LG	2
87	9	Heirets, L	2
88	9	Garcia-Bermejo,I	2
89	9	Kelpser, ME	2
90	9	Lamp, KC	2
91	9	Palmer, SM	2
92	9	Vaara, M	2
93	9	Drobot, GF	2
94	9	Paris, MM	2
95	9	Michele, JM	2
96	9	Udo, EE	2
97	9	Anthony, TV	2
98	9	Lewis, RE	2
99	9	Finlay	2
100	9	Li, RC	2
101	9	De Neeling, AJ	2
102	9	Hill, RL	2
103	9	Green Wood, D	2
104	9	Steffee, CH	2
105	9	Brown, EM	2
106	9	Boyter, AC	2
107	9	Gemmell, CG	2
108	9	Piersimoni, C	2
109	9	Tsang, KW	2
110	9	Adu-Sarkodie, YA	2
111	9	Pringle, M	2
112	9	Donnelly, JP	2
113	9	Hind, J	2
114	9	Jocobs, JA	2
115	9	Spencer, RC	2
116	9	Taylor-Robinson, D	2
117	9	Kibbler, CC	2
118	9	Bermudez	2
119	9	Domingo, S	2
120	9	Gerceken, AA	2

121	9	Sanchez-Carrillo, C	2
122	9	Majcher czyk, PA	2
123	9	Falpiner, FR	2
124	9	Marchese, A	2
125	9	Cotterill, S	2
126	9	Stolk engelaar, VM	2
127	9	Sohail, M	2
128	9	Runert, RR	2
129	9	Martinez, P	2
130	9	Goddard, AF	2
131	9	Marie, JP	2
132	9	Phillips, I	2
133	9	Bergmans, DC	2
134	9	Piddock, LJ	2
135	9	Yee, YC	2
136	9	Gould, IM	2
137	9	Drusano, GL	2
138	9	Gomez, J	2
139	9	Bowker, KE	2
140	9	Courvalin, P	2
141	9	Drusano, GL	2
142	9	Graneberg, RN	2
143	9	Munoz Bellido, JL	2
144	9	Suller, MT	2
145	9	Li, RC	2
146	9	Pikis, A	2
147	9	Gui, GP	2
148	9	Shackley, P	2
149	9	Brown, MN	2
150	9	Chuard, C	2
151	9	Goudrean, C	2
152	9	Midolo, PD	2
153	9	Onody, C	2
154	9	Tajima, Y	2
155	9	Cook, RR	2
156	9	Kayley, J	2
157	9	Konig, C	2
158	9	Kach, CL	2
159	9	Cirioni, O	2
160	9	Biedenbach	2
161	9	Manfredi, R	2
162	9	Somekh, E	2

163	9	Sato, K	2
164	9	Elsom, GK	2
165	9	Hamiltion – Miller, JM	2
166	9	Patey, O	2
167	9	Dewet, PM	2
168	9	Mason, EO	2
169	9	Nau, R	2
170	9	Shibl, M	2
171	9	Gould, EM	2
172	9	Elliott, TS	2
173	9	Prims, JM	2
174	9	Matsumura, N	2
175	9	Hannan, PC	2
176	9	Mogowon, A	2
177	9	Gowild, EM	2
178	9	Burgmann, H	2
179	9	Stone, SP	2
180	9	Schempp, CM	2
181	9	Dawson, J	2
182	9	Mitehill, P	2
183	9	Hwrschmann, JY	2
184	9	Lewis, RE	2
185	9	Apseloff, G	2
186	9	Mainous, AG	2
187	9	Tyrrell, DA	2
188	9	Capassa, L	2
189	9	Lambert, HP	2
190	9	Smith, AW	2
191	9	Burch, DG	2
192	9	Abdullah, AM	2
193	9	Angyo, IO	2
194	9	Beaulac, C	2
195	9	Bramwell, EC	2
196	9	Branthwaite, A	2
197	9	Cunney, RJ	2
198	9	Donati, D	2
199	9	El Ferghani, N	2
200	9	Forgacs, E	2
201	9	Gudiol, F	2
202	9	Khaitovich, P	2
203	9	Kilic, E	2
204	9	Kim, YH	2

205	9	Kini, U	2
206	9	Lei bovici, L	2
207	9	Leover, J	2
208	9	Ling, TK	2
209	9	Maffezzini, M	2
210	P	Mallon, P	2
211	9	Mishro, OP	2
212	9	Morgan, MS	2
213	9	Mud, AJ	2
214	9	Nishojima, S	2
215	9	Paitan, Y	2
216	9	Periti, P	2
217	9	Phillips, AM	2

CHAPTER — V

Application of Bibliometric Laws

After the analysis and interpretation of data, the next step is to check the validity of Bibliometric Laws. This is done as follows :

1. BRADFORD'S LAW OF SCATTERING

The law states that " If a group of journals are arranged in an order of decreasing productivity, i.e. the journals that yield the most relevant articles coming first and the most unproductive last, then the journals will be grouped into a number of zones, each producing a similar number of relevant articles". However, the number of journals in each zone will be increasing very rapidly and show a geometric progression.

The relationship between the zones is to be given by the following equations : $\mathbf{1 : n : n^2}$

Where, 1 is the number of journals and n is a multiplier.

On the basis of this law, all this in the sample were 532 periodicals divided into three zones according to their frequency of occurrence.

In the first zone, 20 periodicals contained 1354 items, in the second zone 122 periodicals contained 1370 items and remaining 390 periodicals contained 1384 items in the third zone.

In other words, we can say that first 20 periodicals have covered 1/3 of the total items, next 122 periodicals have covered 1/3 items and 390 periodicals also covered yet another 1/3 items. This data has been taken from table – 5, Ranking of Periodicals. The analysis very closely shows the phenomena of scattering of items in different zones of journals.

As the nucleus zone contains 20 journals, followed by 122 journals in second zone and 390 journals in third zone, the zone thus identified will form an approximately geometric series :

$$20 : 122 : 390$$

Here $122 = 20 \times 4$ (approx.)

$390 = 20 \times 4 \times 4$ (approx.)

therefore, $20 : 20 \times 4 : 20 \times 4 \times 4$

Substituting $4 = n$

We get $20 : 20n : 20n2$

i.e. $1 : n : n^2$ (where 1 is number of journals in the nucleus and n is a multiplier).

Thus Bradford's Law is proved.

The number of journals in the nucleus can be obtained by plotting f(r) and log n on semilogarithmic graph paper (a bibliograph), where f(r) is cumulative frequency and log n is log of rank of journals as shown in the graph. This graph is drawn with the help of data given in Table – 5.

The log value of 20 journals in the first zone is 1.3010. The log value of 122 journals in the second zone is 2.0863. The log value of 390 journals in the third zone is 2.5910.

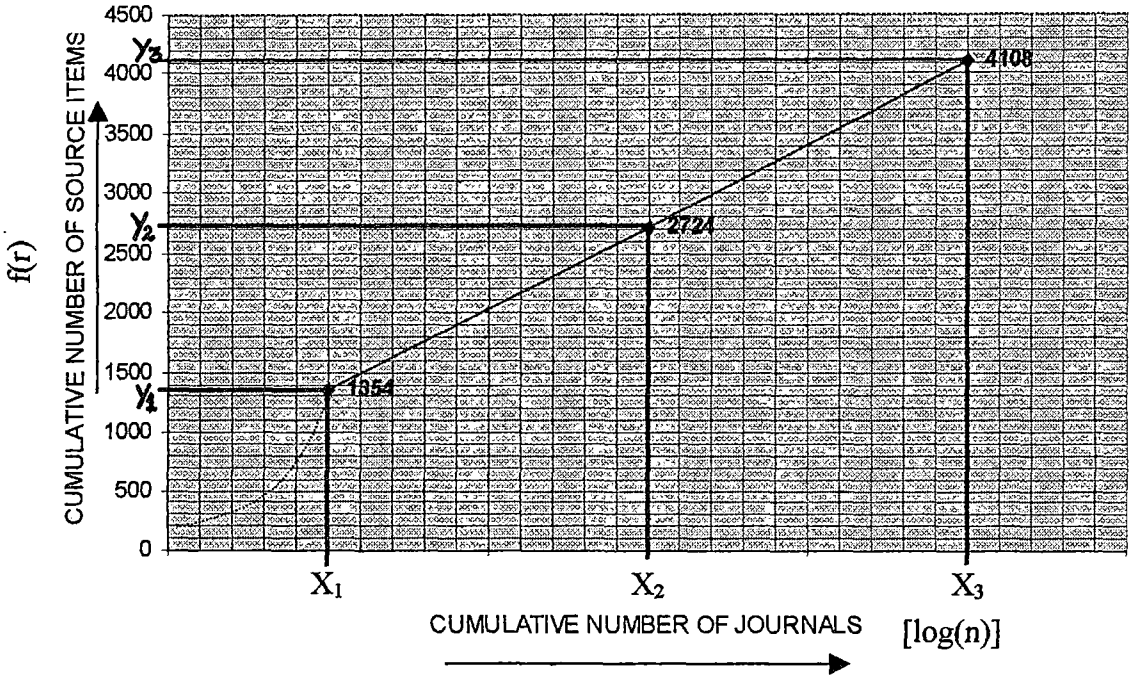
Taking log on X-axis and taking number of items in each zone on Y-axis, a graph was plotted. The bibliograph thus obtained was found to be by and large, similar to Bradford's bibliograph, as the graph begins as a rising curve AP_1 and continues as a straight line. The rising part of the graph represents the nucleus of highly productive journals. The points P_1, P_2 and P_3 on bibliograph are the boundaries of the three equi-productive zones in which almost the same number of articles as the nucleus (represented by $OY_1 = Y_1Y_2 = Y_2Y_3$) derived from an increasingly large number of journals (represented by OX_1, X_1X_2 and X_2X_3). The Bradford's Law is proved thus.

TABLE – 8

Bradford's Table

S.No.	No. of Journals	Cumulation of Journals	No. of Items	Comulation of Items
1.	1	1	175	175
2.	1	2	172	347
3.	1	3	164	511
4.	1	4	102	613
5.	2	6	148	761
6.	4	10	240	1001
7.	3	13	133	1104
8.	2	15	82	1186
9.	4	19	136	1322
10.	1	20	32	1354
			1354	
11.	3	23	83	1437
12.	7	30	177	1614
13.	9	39	185	1799
14.	11	50	151	1950
15.	16	66	161	2111
16.	16	82	167	2278
17.	17	99	150	2428
18.	19	118	146	2574
19.	24	142	150	2724
			1370	
20.	25	167	145	2869
21.	25	192	125	2994
22.	26	218	113	3107
23	27	245	108	3215
24	28	273	98	3313
25.	28	301	86	3399
26.	29	330	102	3501
27.	30	360	95	3596
28.	31	391	105	3701
29.	32	423	94	3795
30.	34	457	103	3898
31.	36	493	100	3998
32.	39	532	110	4108
			1384	

DIAGRAM - 6 BRADFORD'S BIBLIOGRAPH



2. LOTKA'S INVERSE SQUARE LAW

This law states that, the number of scientists who contribute n papers will be $1/n^2$ of those who contribute only one paper.

During the present analysis it was observed that 3743 authors have contributed 4108 items. Out of 3743 authors only 217 authors have contributed more than one paper and rest 3526 authors contributed one paper each i.e. single contribution.

However, according to Lotka's law, single contributors should account for 60% of the total.

Lotka's law was applied to know the number of scientists contributing 2 papers; 3 papers and 4 papers respectively, as given below :

2.1 Scientists Contributing Two Papers

As we know that the number of authors contributing one paper 3526, therefore the number of scientists contributing 2 papers may be calculated by the formula :

$$\text{No. of scientists publishing n papers} = \frac{\text{No. of Scientists publishing 1 paper}}{n^2}$$

$$\text{No. of scientists publishing 2 papers} = \frac{3526}{2^2}$$

$$= \frac{3526}{4}$$

$$= 881.50$$

An analysis of the actual data shows that only 134 authors have contributed 2 papers, which is far less than the 881.50 figure, obtained by applying Lotka's law.

2.2 Scientists Contributing Three Papers

Applying the formula :

$$\text{No. of scientists publishing n papers} = \frac{\text{No. of Scientists publishing 1 paper}}{n^2}$$

$$\text{No. of scientists publishing 3 papers} = \frac{3526}{3^2}$$

$$= \frac{3526}{9}$$

$$= 380.67$$

During the analysis it was found that only 52 authors contributed 3 papers each, which is far less than 380.67.

2.3 Scientists Contributing Four Papers

Applying the formula :

$$\text{No. of scientists publishing n papers} = \frac{\text{No. of Scientists publishing 1 paper}}{n^2}$$

$$\text{No. of scientists publishing 4 papers} = \frac{3526}{4^2}$$

$$= \frac{3526}{16}$$

$$= 220\ 38$$

The analysis of the actual data shows that only 17 authors contributed 4 papers which is again far less than calculated figure 220.38.

It may be therefore concluded that the trends of research now a days have changed as compared to the period when Lotka's law was formulated. This is why it is not possible to testify the Lotka's law, on the basis of analysis of the present data.

3. ZIPF'S LAW OF WORD OCCURRENCE

This law states that "In a long textual matter if words are arranged in their decreasing order of frequency, then the rank of any given word of the text will be inversely proportional to the frequency of occurrence of the word."

$$r \propto 1/f$$

$$fr = c \text{ (Constant)}$$

(where r is rank and f is frequency of word occurrence)

To check the validity of this law, the words were collected. The words have been collected from the title of the articles and represented in Table – 9 according to their frequency of occurrence in decreasing order.

Table – 9 shows that the distribution of words are inversely proportional to the frequency of occurrence of the words. The law represents only approximation of occurrence which is hyperbolic.

Zipf's Law

$$f(r) = c/n \quad \text{where c is constant}$$

or $$\log f(r) + \log n = c$$

On application of this law we found that the log(f) (frequency of occurrence of words) when added to log(r) (their rank), the results are almost the same for each.

I. Word – Antibiotic Frequency – 1042 item Rank – 1

log of frequency + log of rank

= log 1042 + log 1

= 3.0270 + 0

= 3.0270

II. Word – Chemotherapy Frequency – 576 item Rank – 2

log of frequency + log of rank

= log 576 + log 2

= 2.7604 + 0.3010

= 3.0614

III. Word – Treatment Frequency – 525 item Rank – 3

log of frequency + log of rank

= log 525 + log 3

= 2.7201 + 0.4771

= 3.1971

TABLE – 9

Ranking of Words

S No	Rank	Words	Frequency	log(c)
1	1	Antibiotic	1042	3 0170
2	2	Chemotherapy	576	3 0614
3	3	Bacteria	525	3 1971
4	3	Treatment	525	3 1971
5	4	Chloramphenicol	476	3 2796
6.	4	Drug	476	3 2796
7	5	Penicillin	415	3 3169
8	6	Antimicrobial	397	3 3768
9	7	Effect	339	3 3751
10	7	Streptococcus	339	3 3751
11	8	Resistance	327	3 4175
12	9	Susceptibility	306	3 4399
13	9	Infection	306	3 4399
14	10	Disease	277	3 4424
15	11	Activity	248	3 4357
16	11	Invitro	248	3 4357
17	12	Helicobacter	229	3 4389
18	13	Agents	224	3 4641
19	13	Patients	224	3 4641
20	14	Combination	215	3 4785
21	15	Efficacy	208	3 4940
22	16	Clindamycin	205	3 5158
23	17	Microbiological	188	3 5045

CHAPTER — VI

CONCLUSION AND IMPLICATIONS

Bibliometric has established as the most active field of Library and Information Science during the past few decades. The statistical and analytical methods of Bibliometric study are very useful to eliminate low quality literature and to sort out the significant and reliable publications. It is also useful for making the acquisition policy and in providing better services to patrons and knowing the location of materials. To differentiate the properties and trends of the literature on "Antibiotics" a bibliometric study was conducted for the purpose . '*Index Medicus*' was consulted as source document for getting the required data. The field of 'Antibiotics' is a sub-field of drugs, which deals with the chemical substance having the property of killing the growth of those micro-organisms which are injurious to human health.

The study is done to meet the following objectives of bibliometrics :

- To compile a ranked list of journals.
- To find out the individual contribution of significant authors and observe authorship pattern.
- To distribute cited serials according to their country of origin and languages.
- To find out the form of the document used in the subject field.
- To observe chronological distribution and frequency of cited journals.

Table – 1 shows the geographical scattering of items. The literary output of U.S.A is maximum as compared to other countries, as it accounts for 37.14% of the total data. The 2nd, 3rd, 4th and 5th positions were occupied by England (18.93%), Japan (6.32%), Germany (5.57%) and Netherlands (4.67%) respectively. Table shows that 50 countries are producing literature on the subject 'Antibiotics'. It indicates the wide range of the source document. With the help of this study one can get the idea about the most productive country in the field of 'Antibiotics'.

Table – 2 shows that 82.49% literature in the field of 'Antibiotics' is published in English language. About 17.36% literature on 'Antibiotics' is being published in other languages such as Russian (3.74%), French (3.35%),German (2.06%), Spanish (1.81%) and so on. With the help of this study the most productive language in the field of 'Antibiotics' is known.

Chronological study in Table – 3 shows that maximum number of items have originated during the year 1998 (26.99%). The other productive years are 1997 (23.19%), 1996 (22.27%) and 1999 (16.86%). This study shows how currently information is being published in *Index Medicus*.

Formwise analysis reveals that most dominant form in the field of 'Antibiotics'. The foremost conclusion drawn from Table – 4 is that world output is dominant by the periodical articles, as 92.74% of the total data was found to be in form of articles.

Table – 5 gives a ranking list of 265 journals. The most productive periodicals in the field of 'Antibiotics' are :

1.	Journal of Antimicrobial Chemotherapy	175 (4.25%)
2.	Journal of Antibiotics	172 (4.18%)
3.	Antimicrobial Agents and Chemotherapy	164 (3.99%)
4.	Clinical Infectious Diseases	102 (2.48%)

This study will help the librarian in deciding as to which periodicals in 'Antibiotics' may be subscribed in the library.

Subjectwise distribution analysis in Table – 6 shows that 69.91% literature belongs to Medical Sciences. 30% literature is scattered in other disciplines like Biology – Microbiology, Medical Sciences – Communicable Diseases and so on.

Table – 7, Ranking of Authors has been done to know the eminent perisionalities in the field of 'Antibiotics'. From this analysis it was found 3526 items (85.83%) were contributed by more than one author and 582 (14.16%) by

single author. From Table – 7 the following eminent personalities in the subject under the study, were found :

1. Chang, JC (10 items)
2. Stewart, JT (9 items)
3. Telley, CR (8 items)

The Ranking of authors shows the recent trends of research in the subject 'Antibiotics'

At last the bibliometric laws such as, Bradford's Law, Lotka's Law and Zipf's Law have been applied. Among them Bradford's and Zipf's Laws, have been testified as they are still valid today. But Lotka's Law could not be testified probably because of the changing trends of research in modern era.

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